PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

Vol. XXXVI, No. 2, pp. 33–71; 10 figs. September 25, 1968

KEYS TO THE GENERA OF NEW GUINEA RECENT LAND MAMMALS

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Introduction

During the preparation of a report on a collection of New Guinea mammals recently acquired by a Museum of Vertebrate Zoology field party, the lack of comprehensive keys which could be used in the identification of specimens from that area proved to be a serious inconvenience. The existing keys for particular groups are widely scattered through the literature and, although still useful in many respects, are either largely outdated by the discovery of new forms, or difficult to use because of more recent taxonomic and nomenclatorial changes.

On the ordinal and subordinal levels, Thomas (1888) has covered the Monotremata and Marsupialia, and Rümmler (1938) the Rodentia of New Guinea. Miller's (1907) key is still very good for identification of the bats, especially the Microchiroptera, but the large number of genera necessarily included in his work make it tedious to pick out diagnostic characters of the relatively few forms which might be expected to appear in New Guinea. Andersen's monograph on the Megachiroptera (1912), with fewer genera involved, allows a fuller treatment of each and offers fewer problems of identification, although it and all of these papers are in great need of updating.

In a series of papers appearing from 1936 to 1952, Tate presented a wealth of valuable taxonomic work covering most groups of Australasian mammals. However, the virtual absence of comparative characters, summaries, or synoptic keys in the numerous papers offers a distinct handicap to workers with less than his knowledge of New Guinea forms. Wood Jones (1923–1925), although

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covering only certain Australian mammals in detail, lists distinguishing characters and comments on some genera and species which occur in New Guinea and therefore should be among the references consulted in connection with any work on mammals of this geographic area. The notable publications of Ellerman (1941, 1949) are still valuable for identification of rodents although hardly any external characteristics are included in his keys. Also, the distinguishing cranial and dental characters used tend to be generalized and often rather subjective but this is undoubtedly unavoidable in any consideration of rodent genera on a world scale. Walker's recent generic compilation (1964) is, of course, a very informative and, in many respects, a very useful work. It is not, however, sufficiently detailed to be adequate for most identification purposes. Le Souef and Burrell (1926) as well as Troughton (1947) carry the same disadvantages. The semipopular key to New Guinea land mammals by Husson (1955b) is useful in some respects. However, it is mainly concerned with Netherlands New Guinea, it emphasizes skin characters except for the rodents where skull characters are used almost exclusively, and it is written in Dutch and published in a poorly circulated journal. Practically no isolated skull can be identified with this key, nor can most fluid-preserved specimens or skins without skulls. Furthermore, much additional information on New Guinea mammals has become available since this work appeared.

It seems obvious, then, that although the present extent of our knowledge of several New Guinea groups is, at best, rather limited, an attempt toward the compilation of comprehensive identification keys, down to at least the generic level, would be of significant value at this time. Such a set of initial keys, even though more or less tentative in some cases, would nevertheless serve as convenient references for persons whose work requires identification of various New Guinea mammals, but who either do not have ready access to all of the scattered literature or whose schedule does not allow opportunity to perform the necessary selection and tabulation of definitive taxonomic characters. Equally or perhaps more important, the inadequacies of the keys, implicit or explicit, may themselves serve to suggest and stimulate appropriate clarifying investigations by focusing attention on questionable taxonomic points. It would obviously have been highly desirable to extend the present work to include infrageneric categories as well, but at this level the limitations in our knowledge of New Guinea mammals becomes a severe problem, and we have not attempted this at the present time.

Preparation of the Keys

All of the major taxonomic literature, as well as most of the minor publications dealing with New Guinea mammals, has been extensively consulted during the preparation of this paper. Basically we have used the nomenclature, specific compositions, and geographic ranges of genera as listed by Laurie and Hill (1954). However, modifications have been made where more recent papers have suggested that this was necessary. The latter are cited at appropriate locations throughout.

In the present publication, 94 genera are treated. This number includes all terrestrial mammals native or prehistorically established on the mainland of New Guinea, but not necessarily those on adjacent islands. Domesticated species are not considered even though *Sus*, for example, occurs ferally over much of the mainland. Members of three placental orders (Insectivora, Carnivora, and Artiodactyla) which occur on various islands off the coast of West New Guinea (West Irian) are likewise excluded. As reported by Laurie and Hill (1954), these latter genera are in addition to *Sus, Suncus, Crocidura, Viverra, Paradoxurus, Babyrousa*, and *Cervus*.

A much more extensive area is covered by these keys for the Chiroptera. Because of the much greater mobility of bats and hence the greater possibility that genera now unrecorded from New Guinea may show up there in the future, we have included all genera of this order recorded by Laurie and Hill for the entire New Guinea–Celebes area (including the Lesser Sundas and Solomons). For this reason the total of 94 genera includes 18 genera of bats which have not yet been recorded from the mainland of New Guinea. One additional terrestrial genus, *Rhynchomeles*, occurs only on Ceram Island, but is included also in order to complete the treatment of the Peramelidae north of Australia. This leaves 75 genera of Recent land mammals currently recorded from the New Guinea mainland itself.

Of the genera treated in this paper, the Museum of Vertebrate Zoology has specimens of 50. Twenty-nine of these are represented by specimens from localities within the area covered. In addition to this material, we have examined specimens in other collections to the extent that only four of the included genera (*Boneia, Neopteryx, Anamygdon*, and *Baiyankamys*) have not been seen by us in this study, and these are represented by only a single or, at most, a few specimens. Specimens from eight other genera have been examined only from localities outside of the boundaries of our area. These are: *Acrobates, Harpiocephalus, Chalinolobus, Glischropus, Scotophilus, Megaderma, Eonycteris*, and *Cynopterus*. Thus 90 genera have been examined, and for 82 of these material from within the study area has been utilized.

Although many of the genera which live in the area covered by our keys have ranges which extend beyond these boundaries, the characters used, and especially the measurements, do not necessarily hold for all members of the genus outside of this area. The characters appearing in older keys have been checked whenever possible against newer information and the still valid portions of these have been freely drawn upon in constructing the present keys. There are well over 2000 specimens from the Australasian region in the Museum of Vertebrate Zoology. These, as well as the collections of the Field Museum of Natural History and the American Museum of Natural History, have been utilized in checking presumed diagnostic characters and, in many instances, have also provided novel key characters of apparent worth.

After the keys had been completed in a preliminary form, they were tested against the extensive collections of Australasian material in the American Museum of Natural History. The keys were thus further developed and substantiated by this procedure.

Illustrations have been provided in cases where they appear to serve better than a verbal description. It will be noted that certain figures are necessarily rather generalized because they are intended to portray a particular character common to more than one genus. Others, however, are diagnostic for the single genus involved.

Use of the Keys

The keys are based primarily upon cranial and dental characters because, for a majority of genera, these seem to offer a greater number of objective criteria than do external features. However, one or more external characteristics are always provided in each choice at a dichotomy in order that skins unaccompanied by a skull or fluid-preserved specimens from which the skulls have not been removed may also be identified. We have attempted to avoid the use of subjective characters such as "teeth rather selenodont" or "nasal region scantily haired and glandular" but utilization of some of these, especially in regard to external characters, has been found unavoidable in a few instances. The external, as well as some of the cranial, measurements appearing here are those of adult individuals and do not necessarily hold for younger animals. Immature bats may be distinguished from adults by the swollen appearance of the epiphyseal regions of the forelimb metapodials and phalanges in the former. The two conditions are contrasted in figure 8B. At certain steps in the marsupial keys, a correct determination of whether the posteriormost premolar present is either a milk or permanent tooth is necessary before proceeding further. For this reason, either the time of eruption of the adult tooth relative to that of the individual molars, or some other method by which the lacteal and permanent structures may be separated, is noted at appropriate places.

The dental terminology for the Marsupialia and Rodentia is that used by Tate in his most recent review cited for the group involved, except that the three permanent or adult premolars normally present in the marsupial tooth row are uniformly designated as P $\frac{2}{2}$, P $\frac{3}{3}$, and P $\frac{4}{4}$, while the deciduous tooth preceding P $\frac{4}{4}$ is termed DP $\frac{4}{4}$ (after Ziegler, 1967). The tooth homologies of the Megachiroptera are those of Andersen (1912), and for the Microchiroptera they follow Miller (1907).

Explanatory or supplemental notes accompany several of the keys as footnotes and refer to certain steps of each. The exact points or genera to which these notes pertain are indicated by corresponding superscript numerals within the key. Following the generic names at the end of the various key segments, references are generally cited in brackets. These refer the reader to the most recent and extensive reference on the particular genus, which provides additional information such as specific keys, useful illustrations, sets of measurements, or detailed descriptions. Citations to works covering most or all members of a family appear at the beginning of each key and are not repeated for each included genus.

The steps in the keys are all dichotomous, each being designated by an arabic numeral with the second half being indicated by a prime. Following the first number of each key step is another numeral in parentheses which indicates which step of the key one has just come from. This permits an investigator to easily work backwards through a key, if this is desired. The first key is to the 12 families of mammals found in the New Guinea area. This is followed by 11 separate family keys. One family, the Megadermatidae, is not provided with a separate key since it contains only one genus (*Megaderma*) in our area. Diagnostic characters of this form are included in the key to families.

Some useful gazetteers of the region appear in Laurie and Hill (1954), Rümmler (1938), Tate (1951c), and Matschie (1916). All measurements are in millimeters, and for the sake of brevity the following abbreviations are used throughout.

BL—Basal length of skull. Distance from anteriormost point in foramen magnum to anteriormost projection of the premaxillae. Incisors are not included unless noted.

CL—Greatest crown or cingulum length of a particular tooth; measured along the general anteroposterior axis of the tooth whether or not this is approximately parallel to the sagittal plane of the skull.

C^1–M^3—Greatest distance from anteriormost point of canine crown or cingulum to posteriormost extent of terminal molar crown. Roots are not included.

E—Height of ear pinna from crown of head. If measurement is taken from the ventral notch on the lateral surface of the ear, the notation "(n)" is appended.

FA—Greatest length of forearm in bats; taken as a chord, and not an arc, measurement.

HF—Length of hind foot from distal (free) end of calcaneum to base of claw on the longest digit. In cases where the claw length is also included, the notation "(c.u.)" is appended.

$M^{1-2,\ 3\text{ or }4}$—Greatest combined length of the teeth involved; measured at the crown, or cingulum if present; not at roots.

Acknowledgments

We are especially indebted to H. M. Van Deusen, R. G. Van Gelder, and K. F. Koopman of the Department of Mammalogy at the American Museum of Natural History for permission to use their excellent collections for testing and hence greatly improving these keys, as well as for many stimulating discussions on New Guinea mammals. J. C. Moore also generously permitted us to examine Australasian mammals under his care at the Field Museum of Natural History. J. E. Hill kindly loaned us a specimen of *Rhynchomeles* from the British Museum collections.

The illustrations were prepared in their final form by Gene M. Christman, staff artist, Museum of Vertebrate Zoology.

FAMILY KEY TO LAND MAMMALS OF NEW GUINEA

1. Teeth absent. Pelage a combination of hair and rigid spines. .... Order Monotremata, Family Tachyglossidae, page 40

1′. Teeth present. Pelage without rigid spines. 2

2.(1′) Mandible with obvious medially-inflected posteroventral border (fig. 1A); tooth count 28 to 48. Digestive and urogenital systems terminating in a cloaca with a single external opening; mammae in female often enclosed in a pouch, never pectoral in position; testes either abdominal or contained in a scrotum situated anterior to cloacal opening. .... Order Marsupialia 3

2′. Mandible with essentially uninflected posteroventral border (fig. 1B); tooth count 8 to 38. Digestive and urogenital systems with separate external openings; mammae in female never enclosed in a pouch and occurring in either, or both, pectoral and inguinal regions; testes, whether contained in a scrotum or not, situated posterior to urogenital opening. .... Placental orders 6

3.(2) None of lower incisors noticeably enlarged, all subequal, never less than 3. Hind digits II and III (I may occasionally be absent) either free from each other for entire length and about same size as IV and V (didactylous); or, if basal halves or more of II and III united, then hind digit I not large and opposable. 4

3′. Anteriormost pair of lower incisors obviously enlarged and elongated (diprotodont), followed by either one or more markedly smaller unicuspids; or by an obvious diastema. Hind digits II and III (I may occasionally be absent) united basally for ½ or more of their length, often noticeably smaller than IV and V (syndactylous). 5

4.(3) Upper M^{1-3} with 3 labial cusps; I^{1-4} with more-or-less pointed crowns. Hind digits II–V all free from one another and subequal (didactylous). .... Family Dasyuridae, page 41

4′. Upper M^{1-3} with 4 labial cusps; I^{1-4} with more-or-less truncate crowns. Hind digits II and III united basally for about ½ or more of their length and smaller than IV and V (syndactylous). .... Family Peramelidae, page 43

5.(3′) Ventral portion of masseteric fossa without a deep cavity and foramen (fig. 1C); one or more minute teeth often present immediately posterior to enlarged lower incisor. Well-developed hind digit I present. .... Family Phalangeridae, page 45

5′. Ventral portion of masseteric fossa deeply excavated (fig. 1D) and with an obvious foramen in wall; minute teeth never present posterior to enlarged lower incisor. Hind digit I absent. .... Family Macropodidae, page 47

6.(2′) Upper and lower incisors not especially enlarged or elongated. Fore-extremity supporting a flight membrane. .... Order Chiroptera 7

6′. The single pair of upper and lower incisors enlarged and elongated. Fore-extremity not specialized for flight. .... Order Rodentia .... Family Muridae, page 61

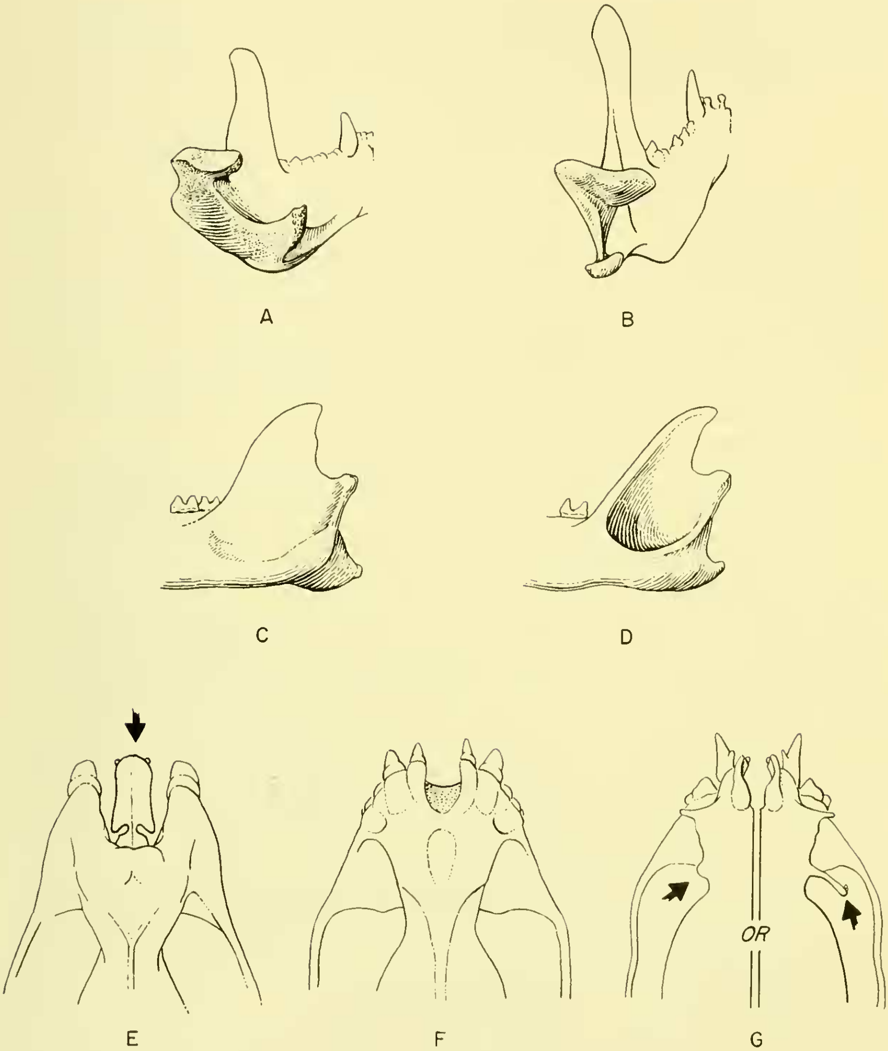

Figure 1. Ordinal and family key characters: A. posterior view of the mandible of a marsupial, showing medially-inflected posteroventral border; B. posterior view of the mandible of a placental mammal, showing lack of a medially-inflected posteroventral border; C. lateral view of posterior end of mandible of a phalangerid to show shallow masseteric fossa; D. lateral view of posterior end of mandible of a macropodid to show deeply excavated masseteric fossa; E. anterior end of skull of rhinolophid bat to show distinctive detached premaxillae and small incisor teeth; F. anterior end of bat skull showing more usual attached condition of the premaxillae, and the lack of definite postorbital processes; G. anterior end of emballonurid skull to show both slightly developed and well-developed postorbital processes.

7.(6) Postcanine teeth with rather rounded cusps and smooth ridges; lower incisors 0 to 2; tooth count 24 to 36. Index claw present or absent; tail often absent; when present its length less than HF (c.u.) length; or, if greater, an index claw present; noseleaf absent. .... Suborder Megachiroptera, Family Pteropidae, page 48

7′. Postcanine teeth with sharp-pointed cusps and angular ridges; lower incisors 1 to 3; tooth count 26 to 38. Index claw never present; tail length greater than HF (c.u.) length; or, if shorter or absent, a distinct noseleaf present. .... Suborder Microchiroptera 8

8.(7′) No upper incisors[1]; tooth count 28: $\frac{-\,-\,-\;1\;-2\;-4\;1\,2\,3}{1\,2\;-1\;-2\;-4\;1\,2\,3} = \frac{6}{8}$; no obvious postorbital process (fig. 1F). Tail absent; large, pointed noseleaf present; FA 50–65; Celebes and other islands W. of New Guinea. .... Family Megadermatidae, genus *Megaderma*
[Anderson, 1918, p. 383; Shamel, 1940, p. 352]

8′. One or more upper incisors; or, if none, obvious postorbital process present (fig. 1G); tooth count 26 to 38. Tail present (although sometimes not visible in *Anthops*, in which case there is a tripartite noseleaf; see fig. 6D); noseleaf present or absent. 9

9.(8′) Postorbital process present, but varies from mere stub to well-developed[2] (fig. 1G); tooth count 28 to 34. Terminal portion of tail emerging from dorsal surface of interfemoral membrane; noseleaf absent. .... Family Emballonuridae, page 54

9.′ No postorbital process (fig. 1F)[2]; tooth count 26 to 38. Terminal portion of tail either completely contained wthin interfemoral membrane or emerging from its posterior margin; noseleaf present or absent. 10

10.(9′) Lower incisors 3, or, if 2 (occasional *Nyctophilus*), premaxillae not projecting freely forward but fused to maxillae laterally (fig. 1F) *and* crowns of lower incisors trifid (rather than bifid); tooth count 28 to 38. Never more than ¼ of tail extending free beyond end of interfemoral membrane *and* tragus present; noseleaf present or absent. .... Family Vespertilionidae, page 56

10′. Lower incisors 1 or 2; tooth count 26 to 32. Tail with either more than ¼ of its length extending free beyond end of interfemoral membrane, or, if less, tragus absent; noseleaf present or absent. 11

11.(10′) Premaxillae projecting freely between anterior ends of maxillae (fig. 1E); tooth count 28 to 32. No tragus; a complex noseleaf present. .... Family Rhinolophidae (including Hipposideridae), page 54

11.′ Premaxillae fused laterally to maxillae (fig. 1F, G); tooth count 26 to 32. Tragus present; noseleaf absent. .... Family Molossidae, page 56

Order MONOTREMATA

Family Tachyglossidae

[Thomas, 1888, p. 374]

1. Basal length of skull less than 130 mm. (80–120); rostrum straight or slightly upcurved. All 5 digits of manus with claws; distance from center of eye to tip of snout less than, to about equal to, distance from eye to ear opening. .... *Tachyglossus*

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[1] In the Rhinolophidae the single pair of upper incisors may be minute, but are located on a distinctive rectangular-shaped premaxilla which is almost completely separated from the maxillae (see fig. 1E).

[2] If the postorbital processes of *Emballonura* are either rudimentary or perhaps accidently broken off, skulls of this genus may be distinguished from those 5 vespertilionids also possessing 34 teeth by the following combination of characters: P^4 at least 4 times the bulk of minute P^2 (rather than less than twice bulk of well-developed P^2 as in *Murina* and *Harpiocephalus*); C^1 and P^4 not in contact, P^2 situated in toothrow between them (in *Chalinolobus* C^1 and P^4 almost or quite in contact, so that P^2 is wedged internal to toothrow); and anteriormost incisor (I^2) unicuspid (bicuspid in *Glischropus* and *Pipistrellus*).

1′. Basal length of skull more than 130 mm. (156–182); rostrum downcurved. Often only middle 3 digits of manus with claws; distance from center of eye to tip of snout about 1½ times distance from eye to ear opening. .... *Zaglossus*
[Thomas and Rothschild, 1922, p. 131; Laurie, 1952, p. 273]

ORDER MARSUPIALIA
FAMILY DASYURIDAE
[Tate, 1947]

Dentition: $\dfrac{1\,2\,3\,4 - 1 - 2\,3\,(D4)/(4)\;1\,2\,3\,4}{1\,2\,3 - - 1 - 2\,3\,(D4)/(4)\;1\,2\,3\,4} = \dfrac{11 \text{ or } 12}{10 \text{ or } 11} \times 2 = 42, 44,$ or 46, with P^4_4 and DP^4_4 being the only teeth of variable occurrence. In those dasyurid genera still possessing DP^4_4, these teeth are apparently retained for widely varying lengths of time. The crown lengths (in mm.) of the milk and adult fourth premolars, as far as known, are compared below for each genus as an aid in determining which dental set is represented in a particular specimen.

1. P^4 present, equal to, or larger in all dimensions than P^3; tooth count 46, premolars: $\dfrac{-\,2\,3\,D4/4}{-\,2\,3\,D4/4}$ (the presence of DP^4_4 in New Guinea *Planigale* [4] is not certainly known). Tail tip not white except in one species of *Murexia* [3] and one of *Antechinus* [4′]; back either unpatterned or with one dark longitudinal mid-dorsal stripe averaging more than 10 mm. (13) wide. ...... (Subfamily Phascogalinae) 2

1′. P^4 either absent, or present but smaller than P^3; tooth count 42 to 46; premolars: $\dfrac{-\,2\,3\,(D4)/(4)}{-\,2\,3\,(D4)/(4)}$ (teeth in parentheses may be present or absent in various combinations). Tail tip white or not; back pattern of 3 types: either with 1 or 3 dark longitudinal dorsal stripes less than 10 mm. wide; white-spotted; or unpatterned; if unpatterned, terminal ⅓ of tail white *and* claws long, narrowly pointed, and nearly straight. .... (Subfamily Dasyurinae) 5

2.(1) M^{1-3} between 4.7 and 5.2 (5.1); nasals not widening abruptly posteriorly (fig. 2A); $P^4_4 = \dfrac{1.3\text{–}1.5}{1.1\text{–}1.3}$, $DP^4_4 = \dfrac{0.9}{0.5\text{–}0.6}$. Width of dried HF at middle of metatarsus only about 3.0; tail 55–134; HF more than 17 (21). .... *Sminthopsis*
[Tate and Archbold, 1941, p. 9]

2′. M^{1-3} either less than 4.7 (4.3) or more than 5.2 (5.3–9.1); nasals widening more or less abruptly posteriorly (fig. 2B). Width of dried HF at middle of metatarsus at least 3.5; tail either 116–240 or, if less (78), HF less than 17 (14). 3

3.(2′) M^{1-3} more than 6.5 (6.6–9.1); condylobasal length 30.0–56.9; $P^4_4 = \dfrac{1.5\text{–}2.5}{1.7\text{–}2.4}$, $DP^4_4 = \dfrac{1.2}{0.8}$. HF 23–41; dark mid-dorsal stripe either present or absent; if absent, tail usually more than 150 (148–240). .... *Murexia*
[Laurie, 1952, p. 293]

3′. M^{1-3} less than 6.5 (4.3–6.4); condylobasal length 26.7 (or less)—34.3; P_4 less than 1.6. HF 14–27; dark mid-dorsal stripe absent; tail usually less than 150 (78–155). 4

4.(3′) M^{1-3} less than 4.7 (4.3); I^2 smallest of posterior 3 incisors; braincase noticeably flattened; $P^4_4 = \dfrac{0.9}{?}$. HF less than 17 (14); tail less than 100 (78). Known in New Guinea from a single specimen (taken near Port Moresby, Papua). .... *Planigale*
[Tate and Archbold, 1941, p. 7]

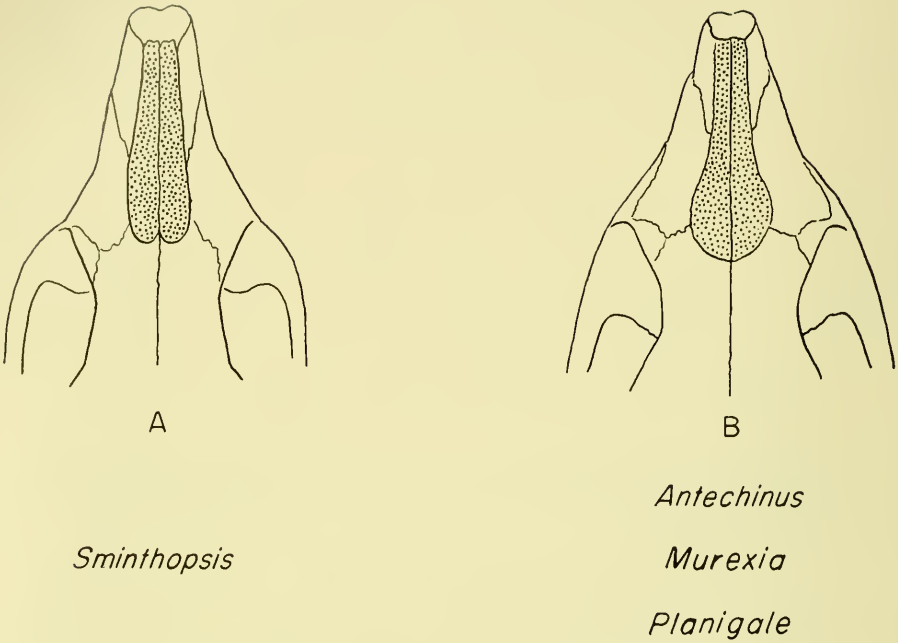

FIGURE 2. Family Dasyuridae: Typical shapes of nasal bones in four genera.

4′. M^{1-3} more than 4.7 (5.3–6.4); I^2 either largest of posterior 3 incisors, or these 3 subequal; braincase not noticeably flattened; $P^4_4 = \frac{1.3\text{–}1.8}{1.2\text{–}1.5}$, $DP^4_4 = \frac{0.7}{0.5}$. HF more than 17 (19–27); tail more than 100 (116–155). .... *Antechinus*
[Laurie, 1952, p. 296]

5.(1′) M^{1-3} more than 11.0 (11.5–13.6); P^4 (and usually DP^4) absent; tooth count 42 or 44; premolars: $\frac{\text{— 2 3 (D4)}}{\text{— 2 3 —}}$ (DP^4, which = 0.6, may be present in very young specimens). Body length usually more than 233 (230–350); upper parts white-spotted. .... *Satanellus*
[Laurie, 1952, p. 292]

5′. M^{1-3} less than 11.0 (6.4–10.0); P^4 (and usually DP^4) present except in occasional specimens of *Myoictis* [7′]; tooth count 42 to 46; premolars various. Body length usually less than 233 (117–235); upper parts never white-spotted. 6

6.(5′) No diastema between I^1 and I^2; diastema present between C^1 and P^2 (about ½ CL of P^2 in extent); tooth count 46; premolars: $\frac{\text{— 2 3 D4/4}}{\text{— 2 3 \ \ 4}}$; $P^4_4 = \frac{1.0\text{–}1.6}{0.6\text{–}1.0}$, $DP^4 =$ 0.6–0.9. No dark mid-dorsal stripe; occasionally melanistic; tail not crested, terminal portion white; claws relatively long, narrowly pointed, nearly straight. .... *Neophascogale*[3]
[Husson, 1955a, p. 285]

6′. Diastema present between I^1 and I^2; diastema between C^1 and P^2 either present or absent; tooth count 42 to 46. 1 or 3 dark dorsal stripes or occasionally melanistic; tail crested or not, white-tipped or not; claws relatively short, broad-tipped, curved. 7

7.(6′) C^1–P^2 diastema present; CL of P^4 59–71% that of P^3; tooth count 46, premolars: $\frac{—\ 2\ 3\ (D4)/4}{—\ 2\ 3\ (D4)/4}$; $P^4_4 = \frac{0.8–1.7}{0.6–1.0}$, $DP^4_4 = \frac{?}{?}$. One dark mid-dorsal stripe; melanistic individuals apparently rare[4]; tail not crested, occasionally white-tipped. .... *Phascolosorex*[3]

[Husson, 1955a, p. 285; Lidicker and Ziegler, in press]

7′. No C^1–P^2 diastema; CL of P^4 66–95% that of P^3; tooth count 42 to 46; premolars: $\frac{—\ 2\ 3\ D4/(4)}{—\ 2\ 3\ \ (4)}$; $P^4_4 = \frac{\text{absent or } 1.3–2.0}{\text{absent or } 0.7–1.4}$, $DP^4 = 0.4$. Three dark dorsal stripes, or often melanistic; tail conspicuously crested terminally, not white-tipped. .... *Myoictis*

[Tate and Archbold, 1937, p. 341]

FAMILY PERAMELIDAE

[Tate, 1948b; Tate and Archbold, 1937: 347–362]

Dentition: $\frac{1\ 2\ 3\ 4\ (5)\ 1\ —\ 2\ 3\ D4/4\ \ 1\ 2\ 3\ 4}{1\ 2\ 3\ —\ —\ \ 1\ —\ 2\ 3\ D4/4\ \ 1\ 2\ 3\ 4} = \frac{12 \text{ or } 13}{11} \times 2 = 46$ or 48 with I^5 being the only tooth of variable occurrence.

1. Bullae obviously inflated, more than 5 mm. (7–9) in greatest width and 10 mm. (11–13) in greatest length; incisors $\frac{5}{3}$. Soles of feet not granular (smooth, cobblestone-like, or transversely wrinkled); antihelix process relatively long, rounded, and often appearing twisted (fig. 3A); pelage hispid; HF 54–70. .... *Thylacis*

1′. Bullae not obviously inflated; less than 5 mm. (3–4) in greatest width and 10 mm. (4–5) in greatest length; incisors $\frac{5}{3}$ or $\frac{4}{3}$. Soles of feet granular (finely or coarsely), and not smooth, cobblestone-like, or transversely wrinkled; antihelix process relatively short, acuminate, and not appearing twisted (fig. 3B); pelage either soft, hispid, or spinous; HF 29–100. 2

2.(1′) Incisors $\frac{5}{3}$, and I^5 not rudimentary. Pelage either soft, or slightly hispid but not obviously spinous; tail 105–258. 3

2′. Incisors generally $\frac{4}{3}$, but if rudimentary I^5 present on one or both sides, much smaller than any of anterior 4 incisors (only about 0.3–0.8 in CL). Pelage either soft, or obviously spinous, but if soft, tail more than 125 (130). 4

3.(2) Condylobasal length (M^4 in place) usually less than 44 (39.7–44.1). Pelage soft and dense; HF less than 38 (29–36[5]); tail usually less than 120 (105–120). .... *Microperoryctes*

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[3] "*Phascogale nouhuysii,*" although considered conspecific with *Neophascogale lorentzi* by Tate (1947, p. 137), has more recently been synonymized with *Phascolosorex doriae* by Husson (1955a, p. 285). We follow the latter author's arrangement.

[4] A.M.N.H. 109593 is almost completely melanistic, but this is the only one like this out of 85 specimens. No other cases of melanism in *Phascolosorex* appear in the literature.

[5] A specimen of *Microperoryctes* in the Bishop Museum (BBM-NG, 22457) has a HF measurement of 38 recorded on the label. However, measurements taken on the dried skin indicate that this is a mm. or 2 too large even for HF (c.u.).

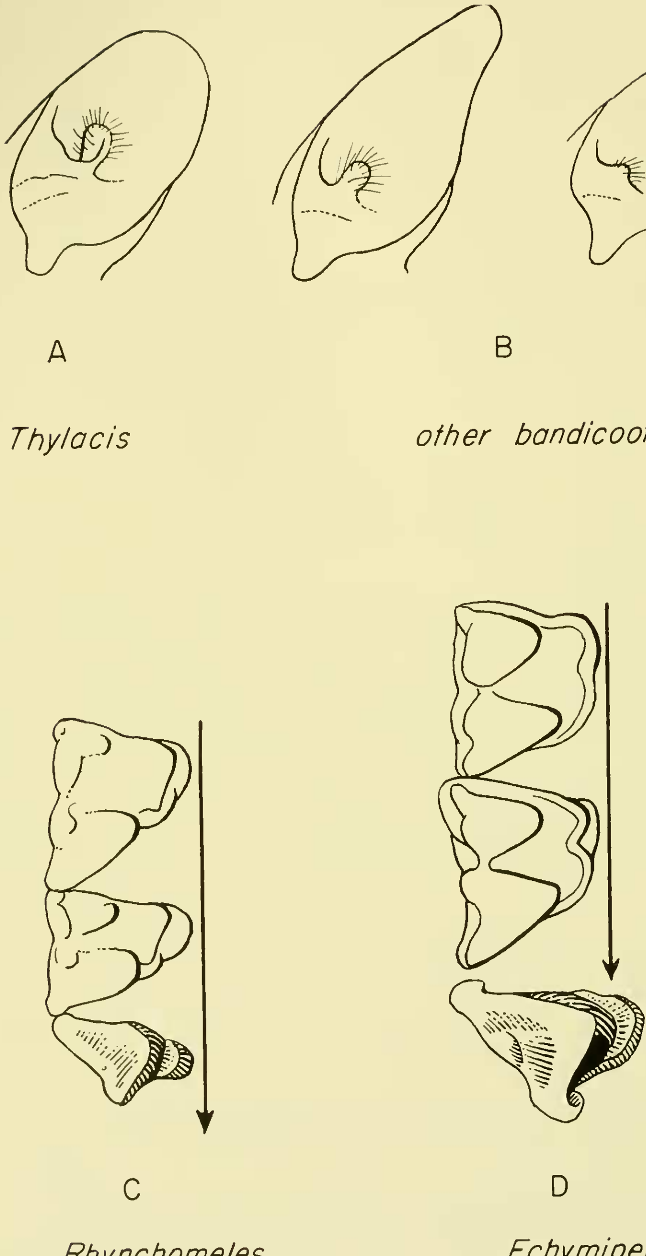

FIGURE 3. Family Peramelidae: A. left ear pinna of *Thylacis* showing large, twisted antihelix process; B. left ear pinnae of other bandicoots showing smaller and non-twisted antihelix processes; C, D. occlusal views of last three right upper molars to show relative development of M^4 in *Rhynchomeles* and *Echymipera*.

3′. Condylobasal length (M^1 in place) usually more than 44 (43.9–108.7). Pelage slightly hispid; HF more than 38 (43–100); tail usually more than 120 (110–258). .... *Peroryctes*

[Laurie, 1952, p. 291; Lidicker and Ziegler, in press]

4.(2′) Inner lobe of M^4 reduced, not extending as far medially as inner lobes of M^3 (fig. 3C). Tail more than 125 (130); pelage soft, not spinous; coloration dark chocolate brown above, only slightly paler below except for a white spot on chest; known only from Ceram I. .... *Rhynchomeles*

[Thomas, 1920, p. 429]

4′. Inner lobe of M^4 not reduced, extending farther medially than inner lobes of M^3 (fig. 3D). Tail less than 125 (52–120); pelage quite spinous; coloration various but noticeably lighter below than above; widely distributed, but not including Ceram I. .... *Echymipera*

[Husson, 1955a, p. 288; Lidicker and Ziegler, in press]

FAMILY PHALANGERIDAE

[Tate and Archbold, 1937, p. 363]

The generic dental formulae in this family tend to be too variable to be used alone as distinctive characters. However, they are listed below primarily as an aid in identification of individual teeth mentioned in the key. The teeth in parentheses are more-or-less vestigial ones which may be expected to be present or absent in various combinations. Their true identities are not at all certain in most cases.

1. Molars selenodont (fig. 4A); I_1 laterally (or obliquely) compressed into a blade (fig. 4C); space between I_1 and first molariform tooth (M_1) largely filled by the well-developed premolariform P_4[6], dentition: $\frac{1\ 2\ 3 — —\ 1\ —(2)\ 3\ (D4)/4\ \ 1\ 2\ 3\ 4}{1(2)- — — \ - \ —(2)(3)(D4)/4\ \ 1\ 2\ 3\ 4} = \frac{10 \text{ or } 11}{6 \text{ to } 9} \times 2 = 32$ to 40. Foredigits I and II obviously opposable to remaining digits; distal ¼ to ½ of tail completely naked only on ventral surface. .... (Subfamily Phascolarctinae) .... *Pseudocheirus*

[Tate, 1945b; Husson, 1964; Lidicker and Ziegler, in press]

1′. Molars bunodont to lophodont (fig. 4B); I_1 rather rodent-like, tip flattened anteroposteriorly (fig. 4D); space between I_1 and first molariform tooth (M_1) never more than half filled by the single large premolariform P_4; dentition various. Foredigit I only opposable to remaining digits; distal portion of tail various. .... (Subfamily Phalangerinae) 2

2.(1′) Molariform teeth $\frac{3}{3}$; basal length 16.5–28.3. Hair along sides of entire length of tail obviously distichous. 3

2′. Molariform teeth $\frac{4}{4}$; basal length 24.0–95.0. Hair of tail sometimes dorsoventrally flattened but never obviously distichous. 4

[6] The $DP\frac{4}{4}$ in all New Guinea phalangerids except *Phalanger* are apparently minute and shed at a very early age (while still in pouch?), so the fourth premolars encountered in the usual museum specimen can probably safely be assumed to be permanent teeth. On the other hand, $DP\frac{4}{4}$ in *Phalanger* are both well-developed and long-retained. However, their size and shape are similar enough to those of $P\frac{4}{4}$ that representatives of either dental set will equally well fit the conditions described for the fourth premolar in this key.

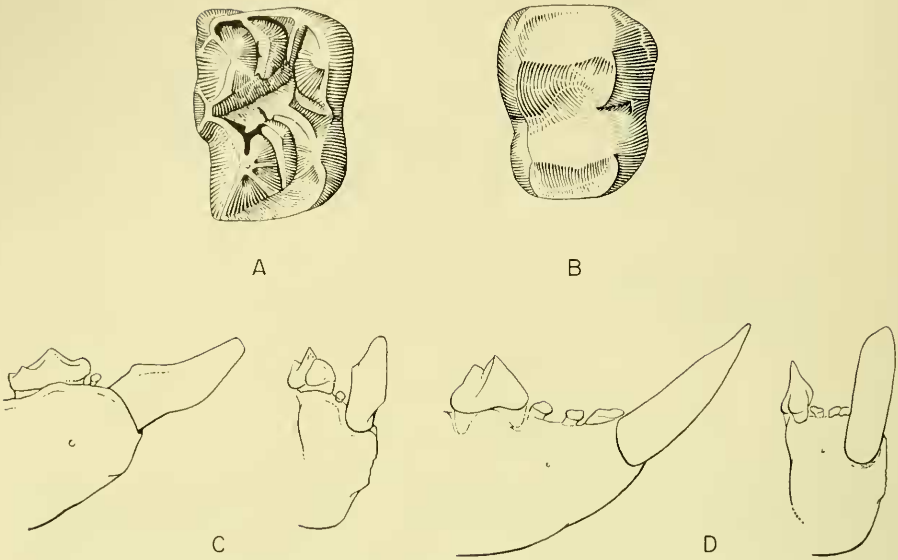

FIGURE 4. Family Phalangeridae: A. occlusal view of selenodont molar of *Pseudocheirus* (right M^{1-3}); B. occlusal view of a molar tooth of *Phalanger* (right M^{1-3}), an example of the bunodont to lophodont molars of the subfamily Phalangerinae; C. lateral and frontal views of the mandible of *Pseudocheirus* showing its laterally compressed incisors; D. lateral and frontal views of the mandible of a *Phalanger* showing the anteroposteriorly flattened incisors of the Phalangerinae.

3.(2) Last upper premolariform tooth (P^4) noticeably shorter in CL than P^3; basal length more than 22 (24.5–28.3); dentition: $\frac{1\ 2\ 3\ —\ —\ 1\ —\ 2\ 3\ (D4)/4\quad 1\ 2\ 3\ —}{1(2)—\ —\ —\ -\ —(2)3\ (D4)?/–\ 1\ 2\ 3\ —} = \frac{10}{5 \text{ to } 8} \times 2 = 30$ to 36. Face white, a dark patch through eye and extending over ear; a similar mark posterior to ear. .... *Distoechurus*

[Tate, 1945c, p. 10]

3′. Last upper premolariform tooth (P^4) subequal in CL to P^3; basal length less than 22 (16.5–19.0 ±); dentition as above, except premolars: $\frac{—\ —\ 3\ (D4)/4}{—(2)\ 3\ (D4)/4} = \frac{10}{6 \text{ to } 8} \times 2 = 32$ to 36. Face grayish-brown, a dark patch through eye, but ending immediately posterior to eye; no dark mark posterior to ear. .... *Acrobates*[7]

[Tate, 1938, p. 59]

4.(2′) Basal length less than 38 (21.8–35.0). Tail usually less than 185 (144–182 ±); if occasionally more, then a gliding membrane present along sides of body. 5

4′. Basal length more than 38 (45.0–95.0). Tail usually more than 185 (190± –605); gliding membrane never present. 6

[7] Tate (1938, p. 60) is inclined to believe that the genus *Acrobates* is not native to New Guinea, but rather that the single known specimen from this area (type of *A. pulchellus*) was perhaps originally transported from Australia as a pet.

5.(4) Basal length less than 27 (21.8–26.2); dentition: $\frac{1\ 2\ 3 \text{——} 1 \text{—} 2\ 3\ (D4)/4\ \ 1\ 2\ 3\ 4}{1(2)\text{-——} - \text{—}(2)(3)(D4)/4\ 1\ 2\ 3\ 4} = \frac{11}{6 \text{ to } 9} \times 2 = 34$ to 40. No gliding membrane; tail evenly short-haired to tip. .... *Eudromicia*
[Matschie, 1916, p. 260]

5′. Basal length more than 27 (28.5–35.0); dentition: $\frac{1\ 2\ 3 \text{——} 1 \text{—} 2\ 3\ (D4)/4\ \ 1\ 2\ 3\ 4}{1(2)(3)\text{-——} - \text{—}(2)(3)(D4)/4\ 1\ 2\ 3\ 4} = \frac{11}{6 \text{ to } 10} \times 2 = 34$ to 42. Gliding membrane present; tail evenly long-haired to tip. .... *Petaurus*
[Tate, 1945c, p. 6]

6.(4′) P_4^6 equalling or exceeding M_1 in height; I^1 neither more than 1½ times bulk of C^1 nor noticeably proodont; C^1 more or less conical and obviously caniniform; dentition: $\frac{1\ 2\ 3 \text{——} 1 \text{—} 2\ (3)\ D4/4\ \ 1\ 2\ 3\ 4}{1(2)(3)\text{-——}\ (1)\ \text{—}(2)(3)\ D4/4\ \ 1\ 2\ 3\ 4} = \frac{10 \text{ or } 11}{6 \text{ to } 11} \times 2 = 32$ to 44. Either one or no darkish mid-dorsal stripe present; distal ¼ to ¾ of tail naked all around; foredigit IV at most only 1¼ times length of III. .... *Phalanger*
[Tate, 1945a; Lidicker and Ziegler, in press]

6′. P_4^6 much shorter than M_1 in height; I^1 3 or more times bulk of C^1 and noticeably proodont; C^1 transversely compressed and therefore rather chisel-like; dentition as in *Phalanger*, except premolars: $\frac{\text{—}\ 2\ (3)\ (D4)/4}{\text{—}(2)(3)\ (D4)/4} = \frac{10 \text{ or } 11}{6 \text{ to } 11} \times 2 = 32$ to 44. Three broad dark dorsal stripes always present; entire length of tail well-haired, naked only on a small ventral area near tip; foredigit IV elongated, 1⅓ to 1½ or more times length of III. 7

7.(6′) Distance between P^1 and P^4 equal to or greater than CL of P^1; interorbital breadth less than 8.8 (6.8–8.7). Combined length of proximal two phalanges of foredigit IV less than 29 (21.0–27.5); claw of this digit not smaller than that of other foredigits; black chin patch (divided medially by a white area or not) present in all except Fergusson I. specimens. .... *Dactylopsila*
[Tate, 1945c, p. 4; Laurie, 1952, p. 278]

7′. Distance between P^1 and P^4 less than CL of P^1; interorbital breadth often more than 8.8 (8.4–9.5). Combined length of proximal two phalanges of foredigit IV more than 29 (32.5–33.7); claw of this digit much smaller than that of other foredigits; black chin patch absent. .... *Dactylonax*
[Tate, 1945c, p. 4; Laurie, 1952, p. 278]

Family Macropodidae

[Tate, 1948a]

Dentition: $\frac{1\ 2\ 3 \text{——}\ (1)\ \text{——} 3\ D4/4\ \ 1\ 2\ 3\ 4}{1 \text{-———}\ \text{—}\ \text{——} 3\ D4/4\ \ 1\ 2\ 3\ 4} = \frac{8 \text{ to } 10}{6 \text{ or } 7} \times 2 = 28$ to 34, with C^1 being the only tooth of variable occurrence, although P_3^3 are apparently shed together with DP_4^4 upon the eruption of P_4^4 in all New Guinea macropodids. As a possible aid in determining whether the anteriormost cheek tooth present in certain younger skulls is P_3^3 or the often-similar P_4^4 it might be noted that in this family P_4^4 erupts, at the earliest, only after M_3^3 has appeared (see Tate, 1948a, p. 248, table 1 for more exact times in individual genera).

1. C^1 usually absent, but when occasionally present, minute and obviously non-functional; CL of P^4 from shorter, to only slightly longer, than that of M^4 (or if M^4 has not yet erupted, the same relationship also almost always holds true for either M^2 or M^3); CL of I^3 clearly greater than that of I^1. A light hip stripe,

not continuous with lighter color of underparts, usually present in adults (often not evident in *T. bruijini*); tail completely furred, but with hairs becoming sparser distally; HF 115–250. 2

1′. C^1 present and usually more-or-less functional; CL of P^4 about 1½, or more, times that of M^1 (or if M^4 has not yet erupted, the same relationship also almost always holds true for either M^2 or M^3); CL of I^3 subequal to or less than that of I^1. Light hip stripe usually absent; if present, continuous with lighter color of underparts; basal ½ to ⅚ of tail thickly furred, abruptly becoming essentially naked for the remainder, or if completely furred then fore and hind limbs subequal in size; HF 90–155. 3

2.(1) Adult basal length (M^3 in sight) less than 103 (70–98); M^{1-2} less than 15; labial groove of I^3 near posterior border of tooth. HF less than 175 (115–167); dorsal coloration various but often quite dark. .... *Thylogale*

[Tate and Archbold, 1937, p. 411; Lidicker and Ziegler, in press]

2′. Adult basal length (M^3 in sight) more than 103 (106–145); M^{1-2} more than 15; labial groove of I^3 near middle of tooth. HF more than 175 (190–250); dorsal coloration relatively light, brown to yellowish-brown ("sandy"). .... *Wallabia*

[Stirton, 1963; Husson, 1958, under *Protemnodon*]

3.(1′) Posterior palatine foramina minute (1–3 mm. long), or absent; in the case of younger animals P^3 with a lingual basin and a posterointernal cusp, the labial face without a basin and therefore sloping rather smoothly from crest to base of crown; tooth widening posteriorly. Hindlimbs subequal in size to forelimbs; tail of approximately equal thickness throughout its length, well-haired to tip. .... *Dendrolagus*

[Rothschild and Dollman, 1936; Lidicker and Ziegler, in press]

3′. Posterior palatine foramina large ($5-15^+$ mm. long); in the case of younger animals P^3 with neither lingual basin nor posterointernal cusp, the labial and lingual faces similar and sloping rather smoothly from crest to base of crown, tooth remaining the same thickness or narrowing slightly posteriorly. Hind limbs obviously larger than forelimbs; tail decreasing in thickness from base to tip, essentially naked terminally. 4

4.(3′) CL of P^4 less than 11.0 (7.8–9.8); M^{1-3} less than 15 (13.2–14.3). HF usually less than 108 (92–108); terminal ¼ to ½ of tail bare and tip usually not white; general pelage coloration dark brown. .... *Dorcopsulus*

[Lidicker and Ziegler, in press]

4′. CL of P^4 more than 11.0 (12.5–14.5); M^{1-3} more than 15 (17.0–18.5). HF usually more than 108 (108–115); terminal ⅙ or less of tail bare and tip white; general pelage coloration medium brown (in mainland species). .... *Dorcopsis*

Order CHIROPTERA

(Keys are for entire New Guinea-Celebes Area)

Family Pteropidae

[Miller, 1907; Andersen, 1912]

1. Tooth count 24, no lower incisors; medial faces of lower canines in contact:

$$\frac{1\ —\ —\ 1\ 1\ —\ 3\ 4\ 1\ —\ —}{—\ —\ —\ 1\ 1\ —\ 3\ 4\ 1\ 2\ —} = \frac{6}{6}.$$

Nostrils obviously tubed *and* yellowish spots 1 to 5 or more mm. in diameter on ears and dorsal surface of wing; FA 47–86; widespread, including New Guinea. 2

1′. Tooth count more than 24, at least one pair of lower incisors usually present.[8] External character combination never as in step 1 above; FA 35–230; widespread, including New Guinea. 3

2.(1) Width of palate across outer edges of M^1 usually less than 7.5 (6.8–7.5); canines, unless heavily worn, relatively quite long and slender, ratio of transverse width at cingulum to height above alveolus for upper tooth less than .365 (.27–.36). No dark mid-dorsal stripe; FA 47–55; New Guinea. .... *Paranyctimene*
[Tate, 1942a; Laurie, 1952, p. 312]

2′. Width of palate across outer edges of M^1 usually more than 7.5 (7.5–12.8); canines relatively shorter and thicker, width-to-height ratio for upper tooth more than .365 (.37–.50). Dark mid-dorsal stripe present although sometimes rather indistinct; FA 50–86; widespread, including New Guinea. .... *Nyctimene*
[Tate, 1942c, p. 341]

3.(1′) Tooth count either 26[8], 28 (normally),[8,9] or 30; if 30, 6 lower postcanines *and* 2 upper incisors:[10] $\frac{(1)2 - 1 -- 3\ 4\ 1\ 2 -}{-(2)- 1\ 1 -- 3\ 4\ 1\ 2\ 3} = \frac{6 \text{ or } 7}{7 \text{ or } 8}$ (those in parentheses may be present or absent in various combinations). No index claw *and* tail present (10–40 mm.) *and* FA over 80 (82–160); posterior half of back appearing naked because unfurred wing membrane is attached along midline of spinal column; widespread, including New Guinea. .... *Dobsonia*
[Cabrera, 1920, p. 107; Lidicker and Ziegler, in press]

3′. Tooth count 30 or more; if 30, never with a combination of 6 lower postcanines *and* 2 upper incisors. External character combination never as in step 3 above; FA 35–230; attachment and amount of hair on wing membrane various; widespread, including New Guinea. 4

4.(3′) Tooth count 30. Index claw always present; if white facial patches present, always accompanied by a white shoulder patch; FA less than 100 (38–96); tail either absent or less than 16;[11] New Guinea and westward. 5

4′. Tooth count 32 or more. Index claw present or absent; if white facial patches present, never accompanied by a white shoulder patch; FA usually less than 100 but much more in some forms (35–230); tail either absent or up to 30;[11] widespread, including New Guinea. 9

5.(4) One upper incisor: $\frac{-2- 1\ 1 - 3\ 4\ 1\ 2 -}{-2- 1\ 1 - 3\ 4\ 1\ 2\ 3} = \frac{7}{8} \times 2 = 30.$[8] FA 80–92 *and* no tail

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[8] Older individuals of *Dobsonia* [3] may lack the single lower incisor, thus giving a total tooth count of 26, which is unique among the pteropids in the area being considered. The only genera in which all lower incisors are normally absent are *Paranyctimene* [2] and *Nyctimene* [2′], each with a tooth count of 24. Also, in *Harpyionycteris* [5] the single pair of lower incisors (not visible in dorsal view) are occasionally missing (giving a tooth count of 28), but the number of upper postcanines is 5 in this genus and only 4 in *Dobsonia, Paranyctimene,* and *Nyctimene.*

[9] *Thoopterus* [7] occasionally lacks the first upper postcanine (P^1), thereby attaining a tooth count of 28; the same as that of normal *Dobsonia* [3]. In this case, the absence of a vertical canal through the postorbital process of the frontal bone in the former genus will serve to distinguish it from the latter, which possesses such a canal.

[10] In *Dobsonia* specimens retaining 2 upper incisors, the anteriormost one is spiculiform and very likely represents a retained milk tooth (see Lidicker and Ziegler, in press) even though here, for convenience, it is designated as the first permanent incisor.

[11] In the case of certain genera, steps 4 and 4′ are ambiguous as regards external characters alone. However, if both alternatives are followed out, one will lead to an obvious dead end while the other will satisfactorily identify the specimen in question.

and no white facial patches; tibia length less than 43% (33.3–42.5) of FA; Celebes. .... *Harpyionycteris*
[Tate, 1951a]

5′. Two upper incisors. External character combination never as in step 5 above; tibia length various; FA 38–96; New Guinea and westward. 6

6.(5′) One lower incisor: $\frac{1\ 2 - 1\ 1 - 3\ 4\ 1\ 2 -}{-\ 2 - 1\ 1 - 3\ 4\ 1\ 2 -} = \frac{8}{7} \times 2 = 30$. White patches above eyes, on nose, and around mouth, as well as on shoulder; FA more than 88 but less than 100 (90–96); calcar length only about 1/6 HF (c.u.); Celebes. .... *Styloctenium*

6′. Two lower incisors: $\frac{1\ 2 - 1\ 1 - 3\ 4\ 1 - -}{1\ 2 - 1\ 1 - 3\ 4\ 1\ 2 -} = \frac{7}{8} \times 2 = 30$. No white facial or shoulder patches; FA less than 88 (38–85); calcar length various; New Guinea and westward. 7

7.(6′) No vertical canal through basal region of postorbital process of frontal bone; C^1 with anterointernal groove but without anterointernal secondary cusp. FA more than 60 (70–76) *and* tail either absent or, if rudimentary, less than 5 mm. *and* ventral fur not darker than dorsal; Celebes. .... *Thoopterus*[9]

7′. Vertical canal through postorbital process; C^1 with either anterointernal groove or anterointernal secondary cusp (but not both). External character combination never as in step 7 above; FA 38–85; New Guinea and westward. 8

8.(7′) C^1 with anterointernal groove, no anterointernal secondary cusp. FA less than 52 (38–49); tail either absent or, if rudimentary, less than 5 mm. (therefore externally very similar to *Macroglossus* [16] but with no trace of a dark mid-dorsal stripe, calcar less than 1.8 (0–1.5), and width of interfemoral membrane along tibia much less than width of lower leg); New Guinea. ....
.... *Syconycteris* (part; see step 14 below for rest of this genus)
[Lidicker and Ziegler, in press]

8′. C^1 with anterointernal secondary cusp, no anterointernal groove. FA more than 52 (55–85); tail more than 5 (8–15); Celebes, Timor. .... *Cynopterus*
[Tate, 1942c, p. 339]

9.(4′) Tooth count 32.[12] Index claw either absent, or if present (*Boneia* [10]) tail more than 22 (about 25); FA 44–110; Celebes, Solomons. 10

9′. Tooth count 34[12,13]: $\frac{1\ 2 - 1\ 1 - 3\ 4\ 1\ 2 -}{1\ 2 - 1\ 1 - 3\ 4\ 1\ 2\ 3} = \frac{8}{9}$. Index claw present, except in *Eonycteris* (part) [15]; tail either absent or less than 22 (to about 20); FA 35–230; if FA between 80 and 92, tibia length more than 43% (43.5–46.0) of FA; widespread, including New Guinea. 13

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12 Individuals of *Rousettus* [17], *Acerodon* [19], and *Pteropus* [19′] sometimes shed P^1, whereupon their tooth count becomes $\frac{7}{9} \times 2 = 32$. The presence of two upper and two lower incisors will then distinguish these variants from *Boneia* [10] which has only one upper incisor, as well as from *Nesonycteris* [11] which has only one lower incisor. The combination of four upper and six lower postcanines in the aberrant specimens of the former three genera prevents them from being confused with *Eonycteris* (part; *E. rosenbergi* [12]), which has 5 postcanines both above and below. In *Neopteryx* [12], the final genus with a dental count of 32, all four of the upper postcanines are separated from each other by diastemata as great as their crown lengths (see figure in Hayman, 1945, p. 573), rather than being nearly, or quite, in contact as in *Rousettus*, *Acerodon*, and *Pteropus*.

13 A few specimens of *Macroglossus* [16] have been reported (as "*Odontonycteris*") which bear an extra terminal upper molar (M^3). The tooth count in these individuals is thus $\frac{9}{9} \times 2 = 36$, a total higher than that possessed by any other Megachiropteran.

10.(9) One upper incisor: $\frac{\text{— 2 — 1 1 — 3 4 1 2 —}}{\text{1 2 — 1 1 — 3 4 1 2 3}} = \frac{7}{9} \times 2 = 32$. Index claw present; FA 95–96; Celebes. .... *Boneia*

10′. Two upper incisors. No index claw; FA 44–110; Celebes, Solomons. 11

11.(10′) One lower incisor: $\frac{\text{1 2 — 1 1 — 3 4 1 2 —}}{\text{— 2 — 1 1 — 3 4 1 2 3}} = \frac{8}{8} \times 2 = 32$. FA less than 57 (44–55); Solomons. ....
Melonycteris[11] (*M. woodfordi* and *M. aurantius*; see step 16 below for rest of this genus)

11′. Two lower incisors. FA more than 57 (60–110); Celebes. 12

12.(11′) Four upper and six lower postcanines:[12] $\frac{\text{1 2 — 1 — — 3 4 1 2 —}}{\text{1 2 — 1 1 — 3 4 1 2 3}} = \frac{7}{9} \times 2 = 32$. FA more than 90 (110); tail absent; Celebes. .... *Neopteryx*
[Hayman, 1945, p. 569]

12′. Five upper and five lower postcanines: $\frac{\text{1 2 — 1 1 — 3 4 1 2 —}}{\text{1 2 — 1 1 — 3 4 1 2 —}} = \frac{8}{8} \times 2 = 32$. FA less than 90 (60–75); tail present (12–20± mm.); Celebes. ....
.... *Eonycteris* (part; see step 15 below for rest of this genus)
[Tate, 1942c, p. 343]

13.(9′) Upper surface of mandibular symphysis approximately parallel to alveolar line; most of larger upper and lower cheek teeth smaller in cross-sectional area than respective canines (may tend to be subequal in some *Syconycteris* [14]). FA less than 77 (35–75); widespread, including New Guinea. 14

13′. Upper surface of mandibular symphysis ascending, forming a marked angle with alveolar line; most of larger upper and lower cheek teeth approaching, or exceeding, the respective canines in cross-sectional area. FA either more than 77 (80–230), or if less (as short as 68 in some *Rousettus*), both an index claw *and* an obvious tail (10–20 mm.) present; widespread, including New Guinea. 17

14.(13) Second lower incisor 1½ to 2 times height of first; all four lower incisors often almost in contact with each other; diameter of any upper incisor about equal to diameter of last upper molar (M^2). Index claw present *and* underparts not darker than upper *and* no longitudinal dark mid-dorsal stripe; FA 38–49; widespread, including New Guinea. (See also note under step 8 above.) ....
.... *Syconycteris* (part; see step 8 above for rest of this genus)
[Lidicker and Ziegler, in press]

14′. Second lower incisor subequal in height to first; lower incisors usually separated from each other by diastemata at least as great as their own diameters; diameter of any upper incisor about ½, or less, diameter of last upper molar. External character combination never as in step 14 above; FA 35–75; widespread, including New Guinea. 15

15.(14′) Occipital portion of skull deflected downwards only slightly, the upper alveolar line, projected backwards, passing through squamosal root of zygoma; second upper postcanine 10 to 15 times bulk of first. No index claw; tail more than 5 (12–20±);

[11] Pohle (1953, pp. 130–132) considers the presence of only one lower incisor (instead of two) and the absence of the index claw in the single species of *Nesonycteris* (*N. woodfordi*) [11] to be a taxonomic character of less than generic value. He therefore synonymizes the genus with the formerly monotypic *Melonycteris* [16′]. Phillips (1966) agrees with Pohle's merger of the two, and additionally names a third species (*M. aurantius*, from Florida and Choiseul islands in the Solomons). This new species, like *M. woodfordi*, has lost both a lower incisor and the index claw. We accept the taxonomic conclusions of these two authors for purposes of the present key.

FA 60–75; widespread, but not including New Guinea. .... *Eonycteris* (part; see step 12 above for rest of this genus)
[Tate, 1942c, p. 343]

15′. Occipital portion of skull strongly deflected downwards, the upper alveolar line, projected backwards, passing through about the middle of the braincase, *i.e.*, well above the squamosal root of zygoma; size of second upper postcanine various. Index claw present; tail either absent or, if rudimentary, less than 5; FA 35–65; widespread, including New Guinea. 16

16.(15′) Second upper postcanine subequal in bulk to first; coronoid process of mandible rising at an angle of about 30° to lower alveolar line. FA less than 52 (35–50); ventral fur not darker than dorsal (therefore, externally very similar to *Syconycteris* [8 and 14] but nearly always with a distinct to indistinct dark mid-dorsal stripe, calcar more than 1.8 mm. (2.0–3.0), and width of interfemoral membrane along tibia at least equal to width of lower leg); widespread, including New Guinea. .... *Macroglossus*[13]
[Tate, 1942c, p. 345]

16′. Second upper postcanine about 5 times, or more, bulk of first; coronoid process of mandible approximately parallel to lower alveolar line. FA more than 52 (55–65); ventral fur darker than dorsal; New Guinea and neighboring islands to the east. .... *Melonycteris melanops*[14] (see step 11 above for rest of this genus)

17.(13′) Occiput not elongate, distance from posterior border of tympanic ring to posterior border of occipital condyles only about 1 to 1½ times anteroposterior diameter of ring. Tail present (10–20 mm.); FA 68–100; calcar length various; widespread, including New Guinea. .... *Rousettus*[12]
[Stein, 1933, p. 92; Tate, 1942c, p. 334; Lidicker and Zeigler, in press]

17′. Occiput elongated, subtubular, distance from posterior border of tympanic ring to posterior border of occipital condyles about 2 to 3, or more, times anteroposterior diameter of ring. Tail either absent or, if rudimentary, less than 5; FA 80–230; calcar length always ¼ to ½ or more HF (c.u.); widespread, including New Guinea. 18

18.(17′) Cross-sectional area of second lower incisor 10–15 times that of first; C^1 with one secondary cusp halfway up posteroexternal face and two smaller posterointernal basal cusps. Body blackish or blackish-brown above; either no mantle of contrastingly colored hair evident across neck and shoulders, or mantle only faintly indicated by slightly more brownish hairs; FA 130–145; Solomons .... *Pteralopex*

18′. Cross-sectional area of second lower incisor only 1½ to 6 times that of first; C^1 without obvious secondary or basal cusps although cingulum may be prominent. Color of body various; a mantle of contrastingly colored hair (usually lighter than rest of back, but occasionally darker) almost invarably present; FA 80–230; widespread, including New Guinea. 19

19.(18′) Cranially and dentally fairly similar to *Pteropus* [19′]; but P^4 and M^1 with well-defined anterointernal tubercle (fig. 5A); M_2 tends to have a distinct posterior (internal) heel (fig. 5C) set off from thick anterior cusps; CL of M_2 subequal to width. Externally many individuals are apparently inseparable from *Pteropus* at the generic level; FA 125–205; white facial markings never present; Celebes and surrounding islands. .... *Acerodon*[12]

19′. P^4 and M^1 without well-defined anterointernal tubercle (fig. 5B); M_2 without a distinct posterior heel (fig. 5D); CL of M_2 often 30% or more greater than width.

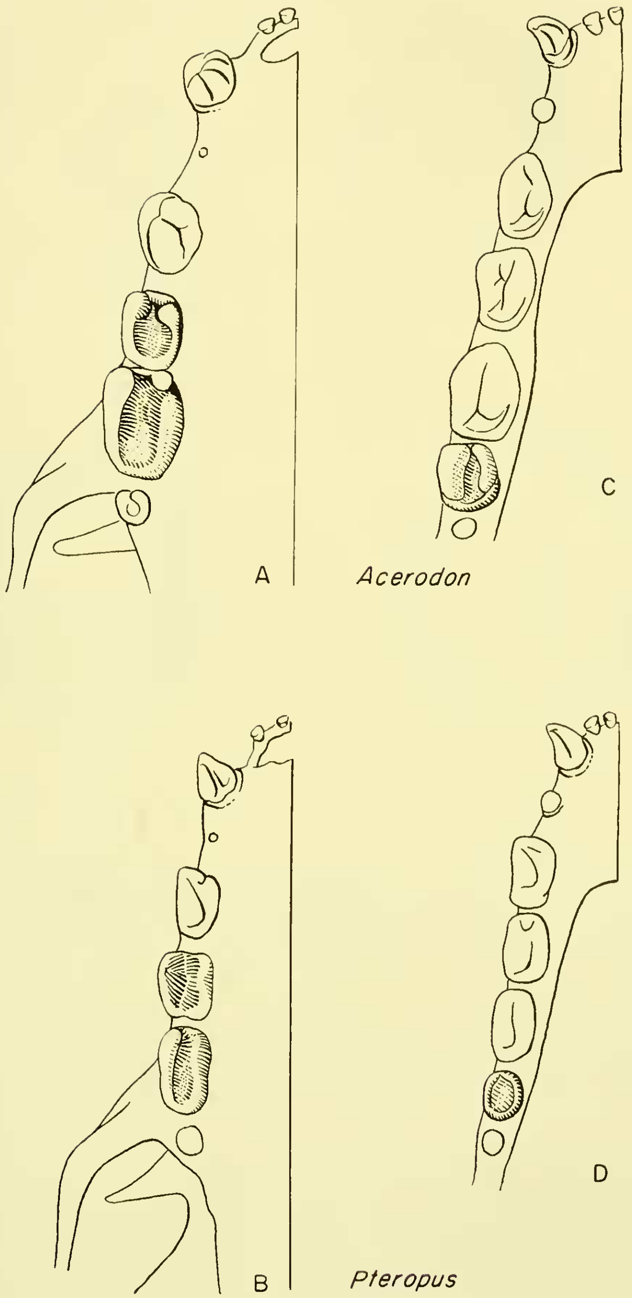


Figure 5. Family Pteropidae: Occlusal views of generalized right upper (on left) and left lower (on right) toothrows of *Acerodon* (A, C) and *Pteropus* (B, D).

Externally apparently inseparable from *Acerodon* at the generic level; FA 80–230; white facial markings present in two species; widespread, including New Guinea. .... *Pteropus*[12]
[Tate, 1942c, p. 335]

FAMILY EMBALLONURIDAE
[Miller, 1907, p. 82]

1. Incisors $\frac{2}{3}$; tooth count 34: $\frac{-\,2\;3\;\;1\;-2-4\;\;1\;2\;3}{1\;2\;3\;\;1\;-2-4\;\;1\;2\;3}=\frac{8}{9}$. Tail less than 20 (6–19); FA usually less than 52 (30–53); widespread, including New Guinea. .... *Emballonura*
[Thomas, 1914a, p. 442; Tate and Archbold, 1939a]

1′. Incisors $\frac{1}{2}$ or, occasionally, $\frac{0}{2}$; tooth count 30 (or 28): $\frac{-(2)-\;1\;-2-4\;\;1\;2\;3}{1\;2\;-\;1\;-2-4\;\;1\;2\;3}=\frac{6 \text{ or } 7}{8}$. Tail more than 20 (21–37); FA usually more than 52 (52–83); widespread, including New Guinea. .... *Taphozous*
[Troughton, 1925; Tate, 1941c]

FAMILY RHINOLOPHIDAE
[Miller, 1907, pp. 106, 109]

1. Tooth count 32: $\frac{-2-\;1\;-2-4\;\;1\;2\;3}{1\;2-\;1\;-2\;3\;\;4\;\;1\;2\;3}=\frac{7}{9}$ (P^2 and P_3 usually very small and wedged, sometimes external to tooth row, between adjacent teeth). Dorsalmost portion of noseleaf consisting of a large single point or "lancet" (fig. 6A); FA 30–75; widespread west of Solomons, including New Guinea. .... *Rhinolophus*
[Andersen, 1918, p. 374; Tate and Archbold, 1939b; Tate, 1943]

1′. Tooth count either 30 or (occasionally) 28: $\frac{-2-\;1\;-(2)-4\;\;1\;2\;3}{1\;2-\;1\;-\;2\;-4\;\;1\;2\;3}=\frac{6 \text{ or } 7}{8}$. Dorsalmost portion of noseleaf not as in step 1 above (figs. 6B–D); FA 33–105; widespread, including New Guinea. 2

2.(1′) Either four or three cochlear whorls evident externally (sometimes very weakly marked); C^1 without accessory cusp on anterior margin, although there may be one present on posterior side; transverse diameter of cochlea (periotic) either less than two times width of basioccipital medial to it, or if more than two times wider (*H. muscinus* group 4 to 8 times wider), then accessory cusp on posterior margin of C^1 absent, 4 cochlear whorls present, sagittal crest extending posteriorly onto parietals, *and* condylobasal length about 15.0–17.5. Dorsalmost transverse margin of noseleaf merely undulate, serrate, or indistinctly trilobate (fig. 6B); FA 33–105; widespread, including New Guinea. .... *Hipposideros*
[Tate, 1941a; Hill, 1963]

2′. Three cochlear whorls evident externally; C^1 either with or without accessory cusp on anterior side, posterior cusp generally present; transverse diameter of cochlea (periotic) two to four times width of basioccipital medial to it (and without combination of characters indicated above for *H. muscinus* group). Dorsalmost transverse noseleaf margin with three discrete projections (figs. 6C, D); FA 35–56; widespread east of Celebes, including New Guinea. 3

3.(2′) Transverse diameter of cochlea approximately two times width of basioccipital medial to it; accessory cusp on anterior edge of C^1, as well as usually on posterior

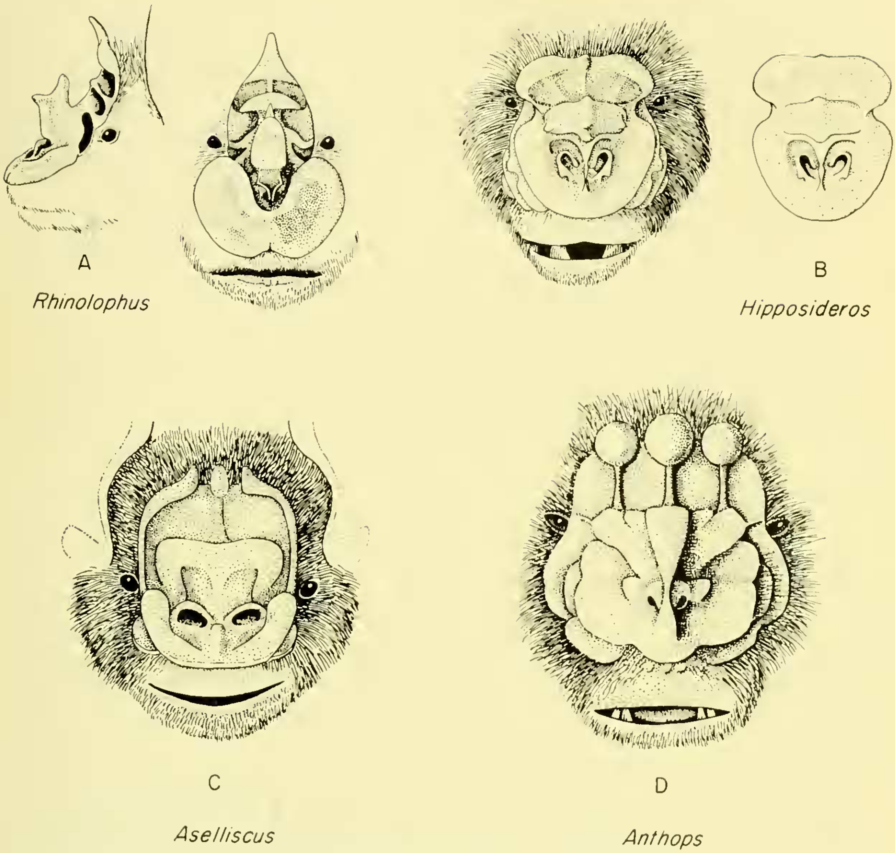


Figure 6. Family Rhinolophidae: Nose leaves and facial features of the four genera in this family. For *Hipposideros*, the left view shows the maximum development of lobing on the dorsalmost transverse leaf in this genus, and the right view typifies the least amount of this development.

edge; condylobasal length less than 15 (12.2–12.5). Lateral dorsal noseleaf projections pointed (fig. 6C); about ¼ of tail extending beyond posterior margin of interfemoral membrane; FA less than 44 (35–42); widespread east of Celebes, including New Guinea. .... *Aselliscus*
[Tate, 1941b, p. 2; Sanborn, 1952, p. 2]

3′. Transverse diameter of cochlea approximately three to four times width of basioccipital; no accessory cusp on anterior edge of C^1, but a small one present near base of posterior edge; condylobasal length more than 15 (17.3); sagittal crest not extending posteriorly onto parietals. Lateral dorsal noseleaf projections rounded (fig. 6D); tail either not visible or extending no more than half way to posterior margin of interfemoral membrane; FA more than 44 (47–56); Solomons. .... *Anthops*
[Tate, 1941b, p. 1]

FAMILY MOLOSSIDAE

[Miller, 1907, p. 241; Meyer, 1899]

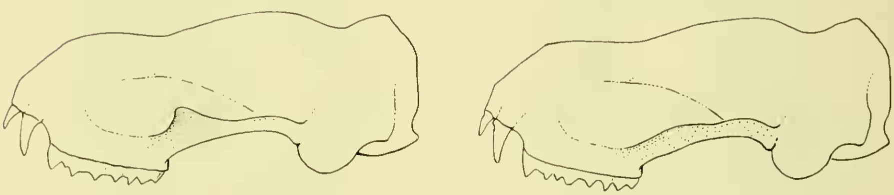
1. Incisors $\frac{1}{1}$; tooth count 26: $\frac{—\;2—\;1———4\;1\;2\;3}{1——\;1\;—2\;\;—4\;1\;2\;3}=\frac{6}{7}$. Animal essentially naked; ears widely separated across forehead; FA more than 68 (70–80); Celebes. .... *Cheiromeles*

[Miller and Hollister, 1921, p. 100]

1′. Incisors $\frac{1}{2}$ or $\frac{1}{3}$; tooth count 28, 30, or 32. Animal normally haired; ears either united across forehead or not; FA less than 68 (30–65); New Guinea and Celebes. 2

2.(1′) Incisors always $\frac{1}{2}$; tooth count 30: $\frac{—2—\;1\;—2—4\;1\;2\;3}{1\;2—\;1\;—2—4\;1\;2\;3}=\frac{7}{8}$; two deep pits or large foramina in the basisphenoid bone; zygomatic arch with well-developed dorsal postorbital projection (fig. 7A). A lighter-colored band obvious across lower neck and upper shoulders, formed by hairs either basally or unicolored buffy to grayish; ears united across forehead; FA 48–60; New Guinea. .... *Otomops*

[Lawrence, 1948; Laurie, 1952, p. 314]



A B

Otomops *Tadarida*

FIGURE 7. Family Molossidae: A. lateral view of cranium of *Otomops*, showing well developed postorbital process on zygomatic; B. lateral view of cranium of *Tadarida*, showing lack of such a well-developed postorbital process.

2′. Incisors either $\frac{1}{2}$ or $\frac{1}{3}$; tooth count 28, 30, or 32: $\frac{—2\;—\;1\;—(2)—4\;\;1\;2\;3}{1\;2(3)\;\;1\;—\;2\;—4\;\;1\;2\;3}=\frac{6\text{ or }7}{8\text{ or }9}$ (those in parentheses may be present or absent in various combinations); basisphenoid without two deep pits or large foramina; zygomatic arch either without, or with only slightly developed, postorbital projection (fig. 7B). Lighter-colored band across lower neck and upper shoulders generally absent, but if present, FA less than 48; ears either united across forehead or not; FA 30–65; New Guinea and Celebes. .... *Tadarida*

[Tate, 1941d]

FAMILY VESPERTILIONIDAE

[Tate, 1941e, f; 1942b]

1. One upper incisor; tooth count 28[15] or 30: $\frac{—2\;—\;1\;———4\;\;1\;2\;3}{1\;2(3)\;\;1\;—2\;\;—4\;\;1\;2\;3}=\frac{6}{8\text{ or }9}$. Either one or two low rounded noseleaves present, or if absent then nasal region

and muzzle scantily haired, glandular, *and* no lobe on lower lip at corner of mouth, *and*, for specimens with FA less than 40 (*Nycticeius* [4]), metacarpal of digit V subequal to that of digit IV, with digit V extending beyond end of proximal phalanx of digit IV; FA 30–64; New Guinea and westward. 2

1′. Two upper incisors; tooth count 32 or more. No noseleaf; if nasal region scantily haired and/or glandular, then either a fleshy lobe present on lower lip at corner of mouth (*Chalinolobus* [10]), *or* FA less than 40 and metacarpal of digit V noticeably shorter than that of digit IV, with digit V terminating about at middle of proximal phalanx of digit IV (*Philetor* [6′]); FA 25–52; widespread, including New Guinea. 5

2.(1) Interorbital region of rostrum depressed so that forehead rises rather abruptly; nuchal crest (if present) not prominent (figs. 8F, G); zygomatic breadth less than 11.5 (8.4–11.4); greatest skull length at least 15 (15.0–19.8). One or two noseleaves present; ears may or may not be united across forehead by a low band; E more than 12 (13–25) in fresh or liquid-preserved animals (but may be as much as 5 to 7 mm. less in some dried specimens); FA more than 37, but less than 47 (37.5–46.5); New Guinea and possibly Timor. 3

2′. Interorbital region of rostrum not depressed so that forehead does not rise abruptly; nuchal crest usually prominent (fig. 8H); zygomatic breadth either more than 11.5 (12.5–14.9), or, if less (10.1–10.8), then greatest skull length less than 15.3 (14.0–15.2). No noseleaf; ears not united across forehead; E less than 12 (about 7 or 8) in fresh or liquid-preserved specimens; FA either less than 37, or more than 47; New Guinea and westward. 4

3.(2) Braincase relatively high (fig. 8F); greatest skull length less than 15.1 (15.0); C–M^3 less than 4.6 (4.5). Anterior noseleaf large and not lobed; posterior noseleaf bilobed and as tall as the anterior; ears united across forehead; FA less than 39 (37.5–39); New Guinea. .... *Pharotis*
[Thomas, 1914b, p. 381]

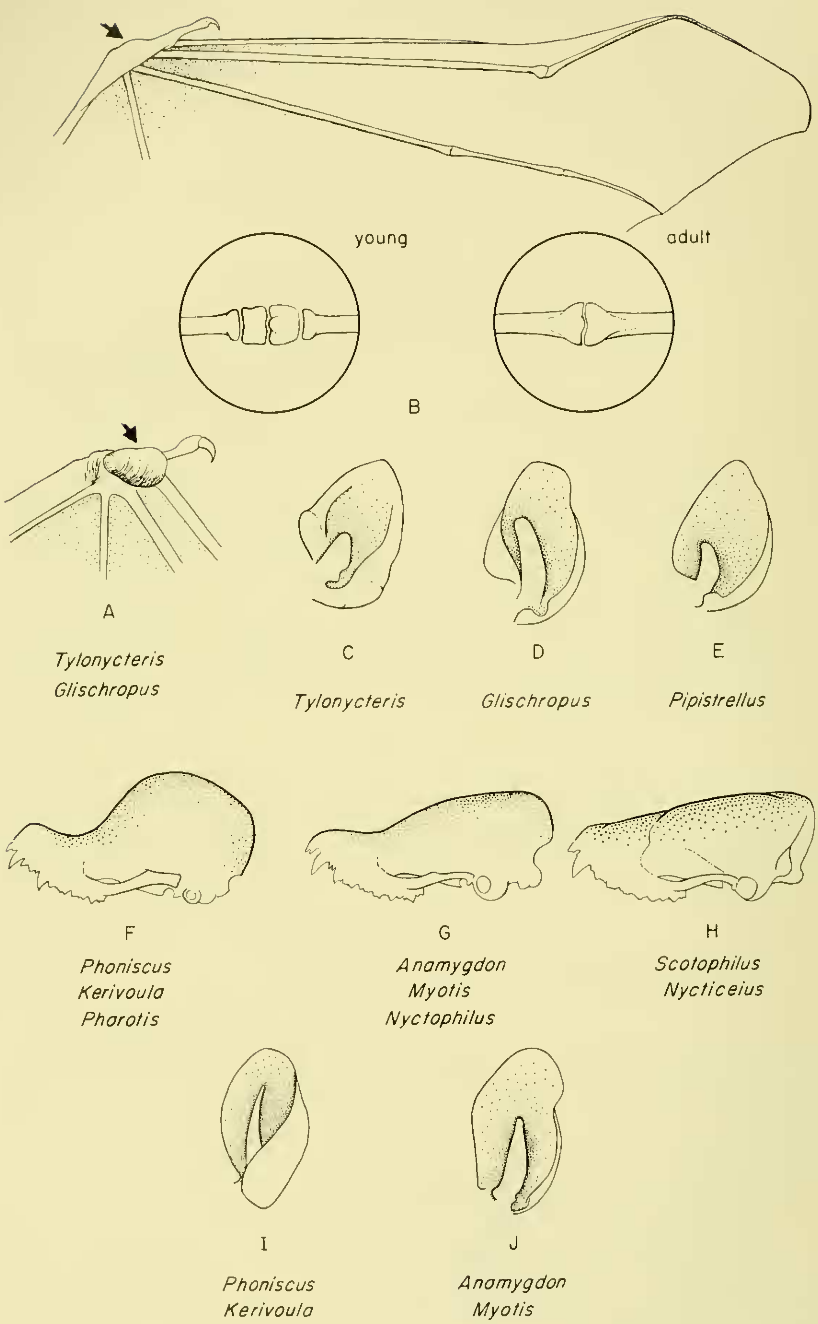
3′. Braincase relatively low (fig. 8G); greatest skull length more than 15.1 (15.2–19.8); C–M^3 more than 4.6 (4.8–7.3). Anterior noseleaf short and weakly trilobed; posterior noseleaf bilobed and usually less well-developed than anterior; ears united across forehead or not; FA more than 37 (37.0–46.5); New Guinea and possibly Timor. .... *Nyctophilus*[15]
[Thomas, 1915; Laurie and Hill, 1954, p. 78]

4.(2′) Greatest skull length less than 16.0 (12.5–14.9); C–M^3 less than 5.8 (4.7–5.5). FA less than 40 (30–36); New Guinea. .... *Nycticeius*
[Tate, 1952, p. 599]

4′. Greatest skull length more than 16.0 (17–20⁺); C–M^3 more than 5.8 (6.0–8.0). FA more than 40 (48–64); Celebes and smaller islands to the south and southeast, but not mainland New Guinea. .... *Scotophilus*

5.(1′) Tooth count 32[16]: $\dfrac{—\,2\,3\;\;1\;\;—\,—\,—\,4\;\;1\,2\,3}{1\,2\,3\;\;1\;\;—\;\;2\,—\,4\;\;1\,2\,3} = \dfrac{7}{9}$. Either a thumbpad present (fig. 8A) *and* tragus relatively short and broad (fig. 8C, *Tylonycteris*), or if thumbpad absent (fig. 8B, *Philetor*), then fur short and unicolored (less than 5 mm. long on dorsum), *and* tail less than 40.5 (32–40), *and* interfemoral membrane not furred dorsally, *and* foredigit V terminating level with about middle of first

[15] *Nyctophilus* [3′] may occasionally lack one of the normal three lower incisors, thus giving a tooth count of 28. This number, however, is unique among the vespertilionids considered in this paper.


young
adult
B
A
Tylonycteris
Glischropus
C
Tylonycteris
D
Glischropus
E
Pipistrellus
F
Phoniscus
Kerivoula
Pharotis
G
Anamygdon
Myotis
Nyctophilus
H
Scotophilus
Nycticeius
I
Phoniscus
Kerivoula
J
Anamygdon
Myotis

phalanx of foredigit IV (rather than extending beyond end of phalanx); FA 25–37; New Guinea and westward. 6

5'. Tooth count 34[16] or more. Thumbpad present (fig. 8A) *and* tragus relatively long, narrow, and blunt (fig. 8D, *Glischropus*), or thumbpad absent (fig. 8B), in which case external character combination never as in step 5 above; FA 28–52; widespread, including New Guinea. 7

6.(5) Skull greatly flattened, height of cranium at (and including) bulla less than 75 percent (55–70) width of braincase just dorsal to posterior root of zygomatic arch; C–M^3 less than 4.5 (4.2–4.4). Thumbpad present; FA less than 30 (25–28); Celebes and islands to south. .... *Tylonycteris*

6'. Skull not greatly flattened, height of cranium at bulla more than 75 percent (80–94) width of braincase just dorsal to posterior root of zygomatic arch; C–M^3 more than 4.5 (4.6–5.0). No thumbpad; FA more than 30 (32–37); New Guinea. .... *Philetor*

7.(5') Tooth count 34[16]: $\dfrac{-\,2\;3\;\;1\;-2-4\;\;1\;2\;3}{1\;2\;3\;\;1\;-2-4\;\;1\;2\;3} = \dfrac{8}{9}$ (P^2 may sometimes be exceptionally small and wedged internal to tooth row between C^1 and P^4). Either nostrils (moderately) tubed *and* dorsal surface of interfemoral membrane densely haired, *or* thumbpad present, *or* lobe on lower lip near corner of mouth, *or* none of these present (*Pipistrellus*, FA 28–38), in which case tragus relatively short and obtuse (fig. 8E) *and* proximal phalanx of fore digit III more than ½ length of remaining distal portion of digit; FA 28–52; widespread, including New Guinea. 8

7'. Tooth count 36 or more. Neither tubed nostrils, thumbpad, nor lower lip lobe present; tragus either relatively long and acuminate (fig. 8I, J), or, if rounded (fig. 8 C–E, *Miniopterus*, FA 36.5–51), proximal phalanx of fore digit III only about ⅓ length of remaining distal portion of digit; FA 30–51; widespread, including New Guinea. 12

8.(7) P^4 less than twice bulk of well-developed P^2; I^3 either larger than, or subequal to, I^2, or, if smaller, then surface area of M^3 only about 1/10 that of M^2. Dorsal surface of interfemoral membrane densely haired; nostrils (moderately) tubed; FA 32–52; smaller islands to east and south of Celebes. 9

[16] Two genera which ordinarily have 34 teeth may occasionally give tooth counts of 32. Ryan (1966) and Johnson (1964) report P^2 sometimes missing in *Chalinolobus* [10]. *Harpiocephalus* [9] has been reported to occasionally lack its vestigial M^3. In the event of the absence of the respective upper tooth in these two genera, they both may be distinguished from *Tylonycteris* [6] and *Philetor* [6'] by their lack of the blunt, anterolaterally directed projection which is present on the anterodorsal orbital rim of the latter two forms. In *Harpiocephalus* the distance from ventral border to tip of ascending ramus of the mandible is well over three times the depth of the horizontal ramus measured from the canine alveolar rim to the ventral border. By this character, it may be distinguished from *Chalinolobus* as well as from *Tylonycteris* and *Philetor*; in each of these three the height of the ascending ramus is, at most, only twice the horizontal ramus depth below the canine.

←

FIGURE 8. Family Vespertilionidae: A. portion of left forewing of bats of the genera *Tylonycteris* and *Glischropus* showing thumbpad (indicated by arrow); B. portion of left forewing of other vespertilionid bats showing lack of thumbpad; left insert shows the bony and cartilaginous elements in a typical finger joint of a young bat, while the right insert shows the same elements in an adult bat; C, D, E. left ears of three genera of bats emphasizing differences in the shape of the tragus; F, G, H. lateral views of the crania of 8 genera of bats, exemplifying various cranial profiles; I, J. left ears of four genera of bats emphasizing the funnel-shaped pinna in *Kerivoula* and *Phoniscus*.

8′. P^1 several times bulk of minute P^2; I^3 slightly to much smaller than I^2; surface area of M^3 more than $\frac{1}{4}$ that of M^2. Dorsal surface of interfemoral membrane essentially naked; nostrils not tubed; FA 28–44; widespread, including New Guinea. 10

9.(8) M^3 reduced to a simple peg or scale, without protocone, paracone, etc.[16] FA more than 44 (48–52); possibly Amboina I. (off SW coast of Ceram). .... *Harpiocephalus*

9′. M^3 normal, bearing protocone, paracone, etc. FA less than 44 (32.7–40); smaller islands to east and south of Celebes. .... *Murina*

10.(8′) I^2 unicuspid, although a cingular ridge may be prominent posteriorly. Lobe on lower lip near corner of mouth; muzzle almost hairless, glandular; FA 32–44; pelage black on head and shoulders; hair tips sometimes silvery; possibly New Guinea. .... *Chalinolobus*
[Ryan, 1966]

10′. I^2 bicuspid (a relatively large secondary cusp immediately behind and about $\frac{2}{3}$ height of main cusp). No lower lip lobe; muzzle normally haired, not glandular; FA 28–38; pelage never contrastingly black on head and shoulders; hair tips not silvery; widespread, including New Guinea. 11

11.(10′) Not always separable from *Pipistrellus* at the generic level in cranial and dental characteristics; greatest skull length 11.4–12.4; C–M^3 4.2–4.7. Thumbpad present (fig. 8A); FA 28–30.5; Batchian I. (in the Moluccas). .... *Glischropus*

11′. Greatest skull length 11.6–15.2; C–M^3 4.1–5.6. No thumbpad (fig. 8B); FA 28–38; widespread, including New Guinea. .... *Pipistrellus*
[Lidicker and Ziegler, in press]

12.(7′) Tooth count 36: $\frac{-\ 2\ 3\ 1\ -\ 2\ -\ 4\ 1\ 2\ 3}{1\ 2\ 3\ 1\ -\ 2\ 3\ 4\ 1\ 2\ 3} = \frac{8}{10}$. Character of foredigit III listed in step 7′ above is unique among genera considered in this paper; in repose and normally in liquid-preserved specimens the portion of digit distal to proximal phalanx is fully flexed ventrally against proximal digital segment; apex of tragus rounded (fig. 8 C–E); FA 36.5–51; widespread, including New Guinea. .... *Miniopterus*

12′. Tooth count 38: $\frac{-\ 2\ 3\ 1\ -\ 2\ 3\ 4\ 1\ 2\ 3}{1\ 2\ 3\ 1\ -\ 2\ 3\ 4\ 1\ 2\ 3} = \frac{9}{10}$. Foredigit III as described for *Pipistrellus* in step 7 above; apex of tragus pointed (fig. 8I, J); FA 30–49; widespread, including New Guinea. 13

13.(12′) I^3 and C^1 almost or quite in contact; braincase greatly rounded (fig. 8F); P^3 from $\frac{2}{3}$ to 1 times cross-sectional area of P^2, never displaced wholly internal to tooth row. Lateral ear margin long and curved anteriorly to give ear a rather funnel-like shape (fig. 8I); fur relatively long; FA 30–43; widespread west of Solomons. 14

13′. I^3 and C^1 separated by a diastema almost as great as, or longer than, diameter of I^3; braincase relatively flat (fig. 8G); P^3 from $\frac{1}{5}$ to 1 times cross-sectional area of P^2, sometimes displaced wholly internal to tooth row (so that P^2 and P^4 are almost in contact). Ear more normal (fig. 8J); fur shorter; FA 30–49; widespread, including New Guinea. 15

14.(13) C^1 without a longitudinal anterolateral groove; greatest basal diameter of I^3 subequal to that of I^2; in dorsal view, anteroposterior length of narial emargination greater than width (ratio about 5:3). No obvious notch in posterior margin of

tragus; FA 30–43; widespread west of Solomons, including New Guinea. .... *Kerivoula*[17]
[Hill, 1965]

14′. C^1 with a longitudinal anterolateral groove; greatest basal diameter of I^3 only ½ to ⅔ that of I^2; anteroposterior length of narial emargination about equal to width. Deep notch in posterior margin of tragus (at level of base of anterior margin); FA 35–41; New Guinea, Celebes. .... *Phoniscus*[17]
[Hill, 1965]

15.(13′) Cranial, dental, and external characters quite similar to various forms of *Myotis*; P^3 from about ⅕ to ¼ cross-sectional area of P^2, wholly internal to tooth row; greatest skull length 15.4; C–M^3 6.0; FA 38.5; tail 35.5; Solomons (known from a single specimen). .... *Anamygdon*
[Troughton, 1929; Walker, 1964, p. 374]

15′. P^3 from about ¼ to 1 times cross-sectional area of P^2, internal to tooth row or not; greatest skull length 12.5–19.3; C–M^3 5.3–6.7; FA 30–49; tail 35.5–51; widespread, including New Guinea. .... *Myotis*

ORDER RODENTIA

FAMILY MURIDAE

[Rümmler, 1938; Tate, 1936, 1951; Ellerman, 1941, 1949]

1. Upper cheek teeth 1 or 2; or, if 3 (*Leptomys*), crown pattern of middle tooth (M^2) as in fig. 9D. Hind digits II–IV, at least, webbed (sometimes only slightly so); *or* pelage soft, close and velvety (shrew-like) and HF less than 24; *or*, if neither of these (*Leptomys* and *Paraleptomys*), externally similar to certain forms of *Rattus*, from which they may be distinguished by characters listed in footnote 18; mammary formula: 0 thoracic pairs—2 inguinal pairs = 4 total mammae in all forms as far as known.[19] .... (Subfamily Hydromyinae) 2

1′. Upper cheek teeth 3; crown pattern of middle tooth (M^2) never as in fig. 9D. None of hind digits webbed; pelage never shrew-like;[18] mammary formula varying from: 0 pectoral pairs—2 inguinal pairs = 4 total mammae to: 3 pectoral pairs—3 inguinal pairs = 12 total mammae. .... (Subfamily Murinae) 11

2.(1) Cheek teeth $\frac{3}{3}$; M^2 pattern as in fig. 9D. HF more than 34 (36–40) *and* hind digits II–IV not webbed. .... *Leptomys*
[Tate and Archbold, 1938]

2′. Cheek teeth less than $\frac{3}{3}$; M^2 pattern various. HF either less than 34 (down to 18); or, if more (up to 66), at least hind digits II–IV slightly to fully webbed. 3

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[17] In considering *Phoniscus* a full genus rather than a subgenus of *Kerivoula* we are following Hill (1965). This author lists diagnostic characters for the two groups as well as for their individual Australasian members.

[18] *Leptomys* [2] and *Paraleptomys* [8] may be distinguished from all New Guinea murines except a few *Rattus* [21] by the following *combination* of external characters: head and body 110–162; tail 130–172; hind foot 28–40; caudal hairs may appear irregularly arranged with respect to the scales, and therefore not clearly 1–3 per scale; at least some tail scales overlapping (fig. 10A) rather than all mosaic (fig. 10B); no hairless unscaled area 5–38 mm. long terminating dorsal surface of tail; white tail tip ordinarily present. A certain number of individuals of the genus *Rattus* remain from which skins of these two hydromyines are not surely separable by these or any other objective characters of which we are aware. Although the hind foot of *Leptomys* is stated by Tate (1951, p. 222) to be elongated relative to head and body (36–40: 124–162), essentially these same absolute measurements may occur in the same ratio in some individual *Rattus*. Both *Leptomys* and *Paraleptomys* have rather soft, dense fur but this subjective characteristic is also occasionally encountered in *Rattus*. The mammary formula of *Paraleptomys* and *Leptomys* is 0–2 = 4, while the minimum in *Rattus* is 1–2 = 6.

[19] Mammary formula unknown only in *Microhydromys* and *Baiyankamys*.

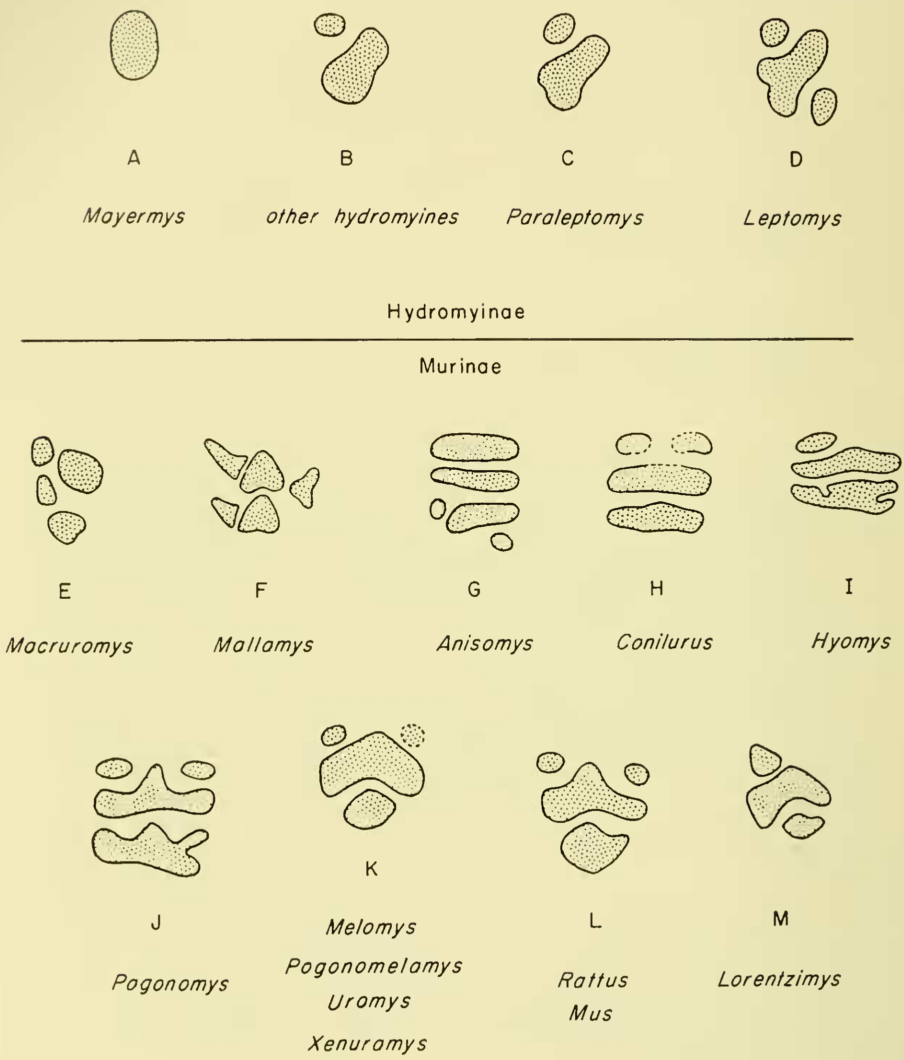

FIGURE 9. Family Muridae: Typical crown patterns of the upper left second molar (modified from Rümmler, 1938, p. 13, fig. 1). The single molar of *Mayermys*, however, is presumably M^{1}_{1}. Cusps indicated with dashed lines are either of uncertain morphology (*Conilurus*), or usually absent (*Melomys*). The small anteriolabial cusp in *Rattus* is also occasionally absent.

3.(2′) Cheek teeth $\frac{2}{3}$ (M^3 lost); M^2 pattern as in fig. 9B. HF between 35 and 40 (36.5) *and* ear more than 11 (13 from crown?). .... *Baiyankamys*[20]
[Hinton, 1943, p. 552]

3′. Cheek teeth less than $\frac{2}{3}$; M^2 pattern various. HF varying from 18 to 66, but if between 35 and 40, then ear less than 11 (6–10). 4

4.(3′) Cheek teeth $\frac{1}{1}$; crown pattern as in fig. 9A; upper tooth about 0.8 mm. long by 0.5 mm. wide. Pelage shrew-like, externally quite similar to other small hydromyines;[21] tail more than 95 (97–113), with lighter colored terminal portion of variable length. .... *Mayermys*
[Laurie and Hill, 1954, p. 133; Lidicker and Ziegler, in press]

4′. Cheek teeth $\frac{2}{2}$ (M^3_3 lost); M^2 pattern various. Pelage various; if shrew-like, see footnote 21; tail length and coloration various. 5

5.(4′) M^{1-2} less than 4.0 (2.1–3.4); condylobasal length less than 27 (20±–25.4); M^2 pattern as in fig. 9B. Pelage shrew-like, dull gray or brownish-gray both dorsally and ventrally; HF less than 26 (18–24); tail less than 110 (77–102). 6

5′. M^{1-2} more than 4.0 (4.4–9.7); condylobasal length more than 27 (28.9–65.0); M^2 pattern various. Pelage not shrew-like, underparts contrasting noticeably with upper; HF more than 26 (28–66); tail more than 110 (120–350). 8

6.(5) M^{1-2} less than 2.3 (2.1); anterior face of upper incisors not grooved. Tail less than 89 (78–88), shorter than head and body; tail generally with lighter colored irregular bands on terminal portion; feet light colored, about same shade as light tail bands. .... *Neohydromys*
[Laurie, 1952, p. 311]

6′. M^{1-2} more than 2.3 (2.4–3.4); anterior face of upper incisors grooved or not. Tail more than 89 (90–101), shorter to longer than head and body; tail with or without lighter colored terminal areas; feet either light-colored or about same shade as darker portions of tail. 7

7.(6′) M^{1-2} less than 2.6 (2.4); anterior face of upper incisors grooved. Head and body less than 84 (80); tail with lighter colored terminal portion, and longer than head and body. .... *Microhydromys*

7′. M^{1-2} more than 2.6 (2.7–3.4); anterior face of upper incisors not grooved. Head and body more than 84 (86–115); tail usually lacking any lighter colored terminal portion, and shorter *to* longer than head and body. .... *Pseudohydromys*
[Lidicker and Ziegler, in press]

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[20] J. E. Hill reports (personal communication) that *Baiyankamys* is an invalid taxon being based on a specimen with a mismatched mandible.

[21] *Mayermys* [4] is externally very similar to the other three equally small hydromyines with more-or-less fine, somewhat shrew-like, pelage. The following external characters, however, may be of aid in distinguishing them from *Mayermys*. Fourteen out of the 15 known specimens of *Pseudohydromys* [7′] lack a white or lightish-colored terminal tail portion which all members of the other three genera possess. Specimens of *Neohydromys* [6] have a tail at least 7 mm. (known range: 7–17) shorter than the head and body while in *Mayermys* the tail is from only 5 mm. shorter, to 18 mm. longer, than the head and body. In *Microhydromys* [7], known from a single specimen, the tail (92 mm.) is 12 mm. longer than the head and body (80 mm.); but both of these measurements are from 5 to 20 or so mm. less than corresponding ones of *Mayermys*. Also, the dorsal surfaces of the hind feet of *Mayermys* are white or light gray, but dusky in *Microhydromys*.

8.(5′) M^2 pattern as in fig. 9C; M^{1-2} 4.4–4.8; condylobasal length 28.9–32.0. HF less than 32.5 (28–32); tail less than 143 (120–140), sparsely haired and without pencil at end; hind digits not webbed. .... *Paraleptomys*
[Tate and Archbold, 1941, p. 1; Osgood, 1945]

8′. M^2 pattern as in fig. 9B; M^{1-2} 4.6–9.7; condylobasal length 31.3–65.0. HF more than 32.5 (33–66); tail more than 143 (145–350), relatively densely furred (fur obscures scales) and with small pencil at end; at least hind digits II–IV webbed. 9

9.(8′) M^{1-2} more than 8.75 (8.8–9.7); CL of M^1 6.1–6.8; interorbital breadth more than 7.6 (7.9–9.3). Pelage relatively harsh and stiff, seemingly not modified for an aquatic existence; only hind digits II–IV webbed. .... *Parahydromys*

9′. M^{1-2} less than 8.75 (4.6–8.7); CL of M^1 3.6–6.3; interorbital breadth less than 7.6 (5.1–7.4). Pelage sleek, with dense soft underfur, obviously modified for an aquatic existence; hind digits either all webbed or only II–IV webbed. 10

10.(9′) M^{1-2} 5.2–5.6; condylobasal length between 36 and 42 (38.2–41.0). Ear less than 5 (0–1); all 5 hind digits webbed. .... *Crossomys*
[Tate, 1951b]

10′. M^{1-2} either 4.6–5.2 or 7.5–8.7; condylobasal length either less than 36 (31.3–34.1) or more than 42 (44.5–65.0). Ear more than 5 (6–22); hind digits II–IV clearly webbed, I and V may or may not be webbed. .... *Hydromys*

11.(1′) M^{1-3} less than 3.8 (2.5–3.5); condylobasal length less than 23 (18.4–22.0). Head and body usually less than 89 (60–91), if greater than 89 (*Lorentzimys*), then small white pencil on tail tip. 12

11′. M^{1-3} more than 3.8 (4.0–19.0); condylobasal length more than 23 (24.8–79.3). Head and body more than 89 (90–470). 13

12.(11) M^2 as in fig. 9M; M^{1-3} less than 2.9 (2.5–2.8); rostrum short and high (fig. 10D). HF more than 19 (21–26); mammae 1–2 = 6. .... *Lorentzimys*
[Ellerman, 1949, p. 89]

12′. M^2 as in fig. 9L; M^{1-3} more than 2.9 (3.1–3.5); rostrum not short and high (fig. 10E). HF less than 19 (16–18); mammae 3–2 = 10. .... *Mus*

13.(11′) M^{1-3} more than 9.4 (9.6–19.0). HF more than 49.5 (50–80); tail scales either overlapping (fig. 10A) or mosaic (fig. 10B), and either annularly (fig. 10A, B) or spirally (fig. 10C) arranged. 14

13′. M^{1-3} less than 9.4 (4.0–9.1). HF either less than 49.5 (20–49), or, if sometimes more (32–59 in *Macruromys* [19]), then tail scales overlapping and annularly arranged, *and* tail more than 130 percent (131–151) head and body, almost always at least one-third white. 18

14.(13) M^2 as in fig. 9G; incisive foramina length less than 5.2 (2.8–4.8); M^{1-3} less than 10.6 (9.6–10.5); M^1 width usually less than 3.0 (2.6–3.0). Tail scales overlapping, annularly arranged; tail 285–338; mammae 1–2 = 6. .... *Anisomys*

14′. M^2 not as in fig. 9G; incisive foramina length more than 5.2 (5.6–16.3); M^{1-3} either more than 10.6 (11.2–19.0), or, if occasionally less (9.5–14.2 in *Uromys* [17′]), then M^1 width usually more than 3.0 (2.9–3.7). Tail scales various, if overlapping and annularly arranged, then tail less than 285 (220–281); mammae various. 15

15.(14′) M^2 as in figs. 9F or I; M^1 width more than 4.5 (5.0–5.9); M^{1-3} 13.4–19.0. Dorsal pelage with very long, generally light-tipped, guard hairs; tail scales spirally arranged, noticeably overlapping and projecting (fig. 10C); head and body 295–470. 16

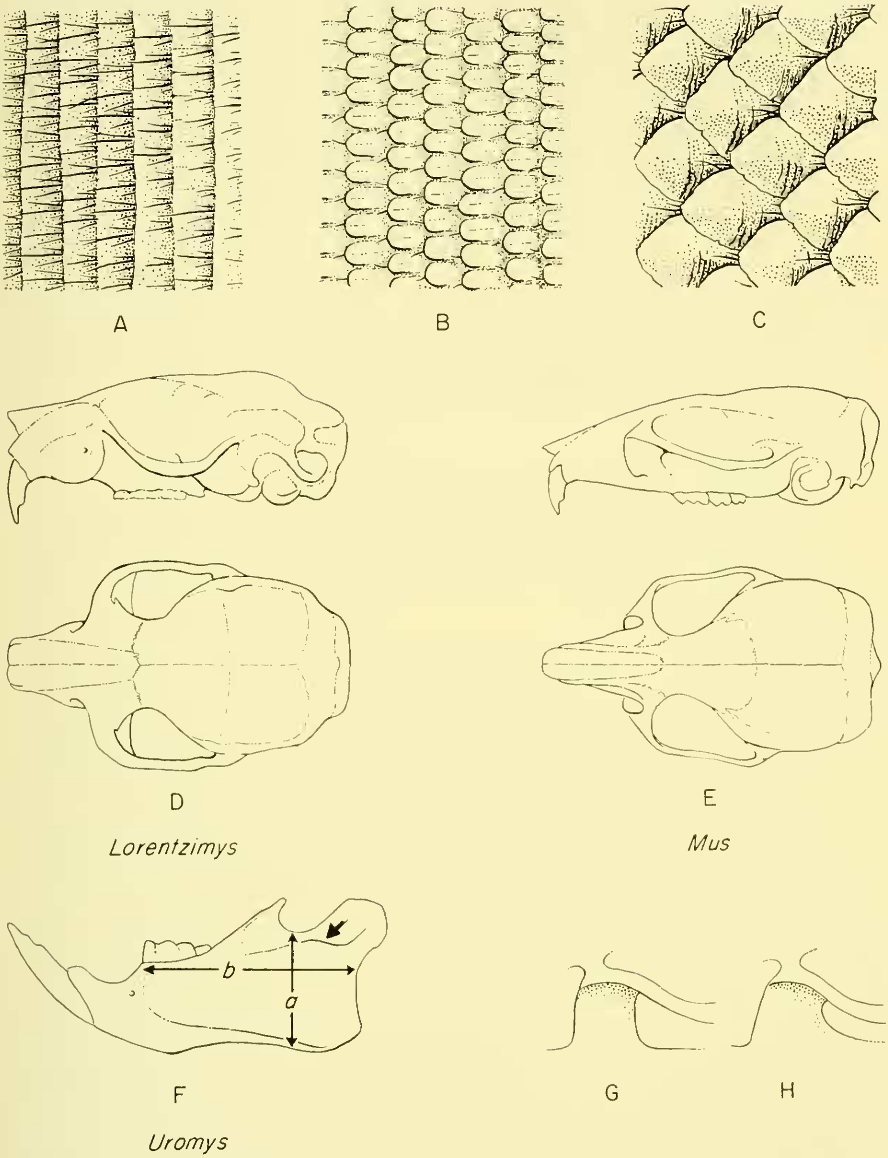

FIGURE 10. Family Muridae: A. overlapping and annularly arranged caudal scales; B. mosaic and annularly arranged caudal scales; C. overlapping and spirally arranged caudal scales; D. lateral and dorsal views of the cranium of *Lorentizimys*; E. lateral and dorsal views of the cranium of *Mus*; F. lateral view of left mandible of *Uromys*, showing height and length measurements used in key (a, b), and laterally projecting process (indicated by unlabeled arrow); G. typical infraorbital plate in *Pogonomelomys*; H. typical infraorbital plate in *Melomys*.

15′. M^2 as in fig. 9K; M^1 width less than 4.5 (2.9–3.7); M^{1-3} 9.5–14.2. Dorsal pelage without very long light-tipped guard hairs; tail scales annularly arranged, either overlapping or mosaic; head and body 241–355. 17

16.(15) M^2 as in fig. 9F; M^{1-3} 16.1–19.0; incisive foramina length 8.6–16.3. Externally similar to *Hyomys* [16′]; never a white patch at base of ear; HF (su) usually 68–80,[22] exceptionally as low as 63.5, HF (cu) 75–85; mammae 1–2 = 6. .... *Mallomys*

16′. M^2 as in fig. 9I; M^{1-3} 13.4–17.5; incisive foramina length 6.5–9.9. Often, but not invariably, a white patch at base of ear; HF (su) 51–68, (cu) 66–75; mammae 0–2 = 4. .... *Hyomys*

[Rümmler, 1933]

17.(15′) Supraorbital ridges absent; frontals not concave; mandible (fig. 10F) without well-developed laterally projecting process and with a/b ratio about 0.5 (probably in all ages); zygomatic breadth 25.4–30.5; M^{1-3} 10.5–11.8. Tail scales overlapping, many scales without hairs, the rest with 1–3 hairs per scale; mammae 1–2 = 6. .... *Xenuromys*

[Tate and Archbold, 1941]

17′. Supraorbital ridges present; frontals concave; mandible (fig. 10F) with well-developed laterally projecting process and with a/b ratio 0.6 or more in full-grown individuals (condylobasal length above about 55); zygomatic breadth 25.5–49.1; M^{1-3} 9.5–14.2. Tail scales mosaic, 0–1 hairs per scale; mammae usually 0–2 = 4, but occasionally 1–2 = 6. .... *Uromys*

[Lidicker and Ziegler, in press]

18.(13′) M^2 as in fig. 9J; incisive foramina length 3.2–5.5. Tail tip modified for dorsal prehension, *i.e.*, terminal dorsal portion hairless and without the normal scalation for at least 13.5 mm. (13.5–38); scales on rest of tail generally overlapping, but may be only slightly so, or even mosaic; if not overlapping, then a variable number of hairs per scale (1–3) and sometimes tail is essentially hairless; mammae 1–2 = 6. .... *Pogonomys*

18′. M^2 not as in fig. 9J; incisive foramina length 3.6–10.9. Tail tip either not modified for dorsal prehension as described in step 18 above, or, if so modified (*Pogonomelomys* [22]), then scales on rest of tail mosaic, 3 hairs per scale and scaleless dorsal area at tip of tail not exceeding 20 mm. in length; mammae various. 19

19.(18′) M^2 as in fig. 9E; M^{1-3} 4.6–7.2. Externally similar to certain larger *Rattus* [21]; tail 188–342, 131–151% head and body, almost always at least one-third white; HF 32–59; tail scales overlapping, 3 hairs per scale; mammae 0–2 = 4. .... *Macruromys*

19′. M^2 not as in fig. 9E; M^{1-3} 4.0–9.1. Tail 84–235, of various percentages head and body; HF 21–49; tail scales overlapping or mosaic; 1 or 3 hairs per scale; mammae various. 20

20.(19′) M^2 as in fig. 9H; incisive foramina length more than 10.8 (10.9); M^{1-3} 9.1. HF 48; tail shorter than head and body, darkening to black on terminal third, and end becoming densely haired so that scales almost obscured; mammae 0–2 = 4; known from only 1 specimen. .... *Conilurus*

[Tate and Archbold, 1938]

20′. M^2 not as in fig. 9H; incisive foramina length less than 10.8 (3.6–10.6); M^{1-3}

[22] One specimen (A.M.N.H. 104153) has a HF recorded on label as 63.2, but this is clearly an error since even the dried foot measures 69.5 (su).

4.0–9.1. HF 21–49; tail length various, often longer than head and body, not becoming either black or densely haired terminally; mammae various. 21

21.(20′) M^2 as in fig. 9L; M^{1-3} 4.0–9.1; incisive foramina length 4.5–10.6. Tail scales overlapping; HF 21–49; head and body 97–285; tail not dorsally prehensile; total mammae count from 4 to 12. .... *Rattus*

21′. M^2 as in fig. 9K; M^{1-3} 4.2–8.6; incisive foramina length 3.6–6.9. Tail scales mosaic except in one form (*Melomys albidens*, which has head and body 111–122, tail 144–162, HF 24–26, and anterior face of upper incisors white to very pale orange); HF 21–43; head and body 90–210; tail dorsally prehensile or not; mammae 0–2 = 4. 22

22.(21′) Cranially and dentally very similar to *Melomys* [22′] at the generic level; anterior edge of infraorbital plate tends to drop straight vertically from root of zygoma (fig. 10G); anterior faces of upper incisors never white to very pale orange; incisive foramina length 4.4–6.2; condylobasal length 24.8–37.7. Tail tip dorsally prehensile and the terminal dorsal portion hairless and without normal scalation for 5–20 mm. .... *Pogonomelomys*

[Ellerman, 1949, p. 86]

22′. Anterior edge of infraorbital plate tends to bulge convexly just below root of zygoma (fig. 10H); anterior faces of upper incisors in 2 species white to very pale orange; incisive foramina length 3.6–6.9; condylobasal length 25.1–42.9. Tail tip may be dorsally prehensile, but terminal portion with normal hairs and scalation all around. .... *Melomys*

[Ellerman, 1949, p. 86]

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